THURSDAY, AUGUST 30, 1917.

SCIENCE AND SOCIETY.

Annals of the Royal Society Club. The Record of a London Dining-Club in the Eighteenth and Nineteenth Centuries. By Sir Archibald Geikie. Pp. xv+504. (London: Macmillan and Co., Ltd., 1917.) Price 18*s*. net.

THIS is a delightful book, not only for fellows of the Royal Society, not for scientific circles only, but for all those who love the biographical side of history, varieties of manners, and the characters of English folk. Moreover, the story of the Royal Society, and of the Club, its inner and more sociable group, is concerned with the most interesting section of English society; or, to be quite modest, let us say of the English society of the eighteenth and nineteenth centuries. No person, whatever his rank, could find admission to this circle without intellectual distinction, while with such distinction none was of origin too humble to fail of a welcome. And, from its beginning onwards, the Club was habitually entertaining as its guests the most distinguished men of the day.

It is impossible to fix the date of the origin of the Royal Society Club, for, like most of such bodies, it grew rather than was founded; it grew out of such tavern parties as Samuel Johnson loved. It took definite form about 175 years ago, when it was called the "Royal Philosophers," a name abbreviated to "The Royals." After some changes from tavern to tavern the Club settled down at the "Mitre," in Fleet Street, and stayed there for forty years. The title of "Club" crept in, at first colloquially, then was formally adopted. The hour of dinner slowly descended from 4 o'clock to 6.30, where it still remains.

The sketch of the history of the Club by Admiral Smith, pleasing and genial as it is, still is but a sketch. For the fuller history before us the Club most happily found its annalist—for in the form of annals the book is written—in Sir Archibald Geikie, during whose presidency the Royal Society had a representative almost as distinguished in literature and humanity as in science. Sir Archibald Geikie knew intimately the sources of his illustrative materials—in Horace Walpole, Boswell, Mme. D'Arblay, Sir Henry Holland, the "Dictionary of National Biography," and so forth. From these and other records he has written a volume which will not by any means be confined to the circle for which in the first instance it was written.

Not the least of its attractions is the series of portraits—thirty-nine in number; among them a print of Hogarth's fine portrait of Martin Folkes (president 1741–52). Hogarth dined more than once with the Club.

The records of the Club, a few gaps apart, have been kept with care, the earlier volumes daintily bound in red morocco. In them we read of much hearty feasting and good fellowship. Gifts of venison at times were so abundant that extra meetings had to be held for the eating of them. Mr. Hanbury is thanked for "a mighty chine of beef of 112 lb. weight," a joint at which Lord Rhondda would gravely shake his head; in 1754 Lord Anson from the Admiralty sent a turtle which weighed 115 lb.; afterwards gifts of these succulent cattle, from him and other friends, became more frequent. Lord Marchmont more than once bestowed on the Club a "particular dainty in the shape of pickled salmon, as sent to the East Indies." A specimen bill of fare at the "Mitre" on January 23, 1758, was as follows:—

Present: Earl of Macclesfield (president), Earl of Morton, Lord Willoughby, Lord Charles Cavendish, Mr. Burrow (treasurer), and other nine members and three guests.

Veale Soup	Soup and Bouille
Fresh Salmon and Smelts	Cod and Smelts
Two dishes of Chickens	Ham
Boiled Turkey and Oyes[trs]	Rump of Beef aladobe (à la daube)

Lamb pye with Cocks-combs, etc.

Lord Macclesfield was a mathematician and astronomer of some distinction.

Among the guests at various dates we find, taken at hazard, General Oglethorp, the friend of Johnson, Laurence Sterne, Pennant, Benjamin Franklin, Poniatowski, the Duc de Nivernais, Helvetius, Captain Cook, Paoli and Boswell, and, among scores of others, Henry Cavendish, who dined more than once as the guest of his father, Lord Charles Cavendish. This friendly record, and that of the proposal of Henry on one of these occasions as a member of the Club, may take their place with the evidence of other memorials, such as joint laboratory work, to refute the story that the relations between father and son were not quite harmonious. Sir Archibald draws a vivid picture of Henry Cavendish, an odd, pathetic figure, shrinking from society, indifferent to fame, yet seeking in his constant attendance at the Club table a relaxation from his studies and a relief from his solitude.

Partly on account of the long waiting list of the Club, partly to combine more formally intellectual discussions with the convivial, in 1847 the Philosophical Club was founded—in no rivalry with the Royal Society Club, for many fellows of the Royal Society were members of both clubs. Ultimately, however, in 1901, the new was merged in the parent club, the prosperity of which continues unabated. Its present "tavern" is Prince's Restaurant, in Piccadilly.

Full of social gossip, gracefully and humorously told, this volume may be cordially recommended to all readers interested in the last two centuries of English home life. And to them another and a pregnant reflection may occur, namely, the great place, the dominant place perhaps in British science, of the amateur. If in certain respects this character of us has been, and yet may be, a source of weakness, in others, and especially in originality and touch with life, it has been a precious tradition. In the pursuit of science more drudgery and more business are now required of us, but let us hope these may be gained without suffering the narrowness and harshness of an army of mere experts.

C. A.

RINGS.

Rings for the Finger: From the Earliest Known Times to the Present, with Full Descriptions of the Origin, Early Making, Materials, the Archaeology, History, for Affection, for Love, for Engagement, for Wedding, Commemorative, Mourning, etc. By Dr. G. F. Kunz. Pp. xviii+381. (Philadelphia and London: J. B. Lippincott Co., 1917.) Price 28s. net.

THE author of the volume before us is well known as one of the leading authorities in the world on all that pertains to the æsthetic and scientific aspects of jewelry. If our memory has not misled us, in the preface to one of his books he claims to possess a collection of literature relating to precious stones and jewelry which, in point of view of extent and completeness, is unsurpassed by any other private library. Unlike not a few owners of large libraries, he evidently does not allow the volumes to lie idle on the shelves; he takes them down and reads them, and notes down any item that strikes him as of unusual interest. His teeming notebooks have provided material for a series of books on subjects connected with jewelry, and now in this sumptuous volume, which is issued at a correspondingly sumptuous price, he pleasantly and discursively treats of an article of ornament that has for countless years played a conspicuous part in the domestic and ceremonial life of man—and especially woman.

The origin of the ring is wrapped in obscurity. Dr. Kunz thinks that it may have been evolved in either or both of two ways. In very early times it was the practice to carry on the person a cylindrical seal, and no doubt it occurred to someone that a convenient way of carrying it was to place it upon the finger. Another likely source was the knot; the true-lovers' knot is familiar to-day, and a twisted piece of metal wire or a knotted cord was a favourite talisman in primitive times. The ring as we know it now has not been traced back farther than the Bronze age. Some sixteen years ago M. Henri de Morgan discovered in the valley of Agha Evlar, near the Caspian Sea, several sepulchral dolmens which, when opened, were found to contain a considerable number of metal, stone, and glass ornaments, among them being bronze rings. They are supposed to date back to about 2000 B.C., but the date cannot be fixed because of the lack of inscriptions. The rings found in the tombs at Enkomi, Cyprus, can be dated with greater precision; they are of Egyptian manufacture, and belong to the period of about 1400–1000 B.C. There appears to be no doubt that the manufacture of rings originated in Egypt and spread thence to Greece and to Italy. Among the Romans the wearing of rings was at first rigidly confined to senators and the patrician class, and it was not until the third century A.D. that these restrictions were swept away. The early form of ring was very simple, consisting merely of a bent piece of wire fastened to the scarab or whatever was the object worn; complete rings appear to have been first made in the Golden age of Egyptian civilisation.

When the author passes on to the other topics discussed in the book, such as signet rings, interesting rings, betrothal and religious rings, and rings used as talismans or for healing, he traverses ground already to some extent trodden in his previous works. Some interest attaches to a form of ring seldom seen to-day, viz. the hololithic, *i.e.* one which is wholly—circlet and chaton—cut out of a single stone. Such rings were, however, common in days of archery, when rings made of agate or chalcedony were used to protect the thumb of the hand holding the bow from being cut by the string as it straightened after the arrow had sped on its course. Five rings of the kind made of agate, carnelian, mocha-stone, or jasper were included in the collections which were bequeathed to the nation by Sir Hans Sloane in 1753 and led to the formation of the British Museum. The most wonderful hololithic ring on record is one measuring about 1¼ in. in diameter and cut from an unusually beautiful emerald; dependent from it are two fine emerald drops, and rose diamonds bordered with rubies are set in two collets. It was made to the order of the great Jehangir Shah, and was engraved with his name. After passing through many vicissitudes the ring was given to the British East India Company by the unfortunate Shah Shujah, and was afterwards acquired by Lord Auckland.

In the last chapter the author describes carefully the modern manufacture of rings by means of machinery, and illustrates the various stages from the wire to the finished article. Some idea of the magnitude of the industry may be gauged by the fact that a single factory in the United States has turned out upwards of three million rings in a year.

Dr. Kunz in the course of the book describes many of the more famous rings contained in the British Museum collections, and constantly refers to the catalogues of the rings in that institution. He gives a facsimile of a sketch made by Sir C. H. Read of a seal-ring on a finger of a bronze statue of the third or fourth century. A curious mishap has occurred on p. 86, probably in the course of paging the book: the last five lines at the foot of the page, excluding the foot-note, should have been inserted in the middle of the page. Possibly had the publication of the book been delayed a few months the following sentence on p. 160 might have been worded a little differently: "The gems with which they are set were bought by the Rev. Dr. John P. Peters from an Arab in the Kut-el-Amara region, where the British invaders of Mesopotamia underwent such a disastrous defeat." The illustrations to the book are, from the point of view of reproduction, of exceptionally high quality, but they appear to have been selected a little at random. It is not clear why a letter from Admiral Peary and one from Sir Sidney Lee and Mr. F. C. Wellstood were reproduced in facsimile; they really add nothing to the value or interest of the book. There is an excellent index.

TWO BOOKS ON MINERALS.

(1) *A Pocket Handbook of Minerals, Designed for Use in the Field or Classroom, with Little Reference to Chemical Tests.* By Prof. G. Montague Butler. Second edition. Pp. ix+311+table in 5 folding sheets. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., n.d.) Price 11s. 6d. net.

(2) *Microscopical Determination of the Opaque Minerals: An Aid to the Study of Ores.* By Dr. J. Murdoch. Pp. vii+165. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 9s. 6d. net.

THESE two books form a useful addition to the already large number of American publications on determinative mineralogy.

(1) Prof. Butler's volume, now in its second edition, is specially designed for use in the field, and can easily be carried in the coat-pocket. A brief account is given of each mineral, and there is a useful table of the most characteristic properties of the different species, so that the recognition of a specimen should as a rule present little difficulty. The table does not, however, include specific gravity, one of the most generally useful means of identification. Even in the field a Walker's balance, or for smaller specimens the simple arm balance employed by Penfield, is available. The work appears on the whole to have been well done, though in a book containing so much detailed information there are naturally some points open to criticism. Oligoclase is described quite correctly as Ab_6An—Ab_3An, but a note is added that $Ab=Na_2O.Al_2O_3.6SiO_2$ and $An=CaO.Al_2O_3.2SiO_2$. This is misleading, for according to general usage Ab only represents half the amount of albite indicated by the former formula. Garnierite is not now the most important ore of nickel. The "compact fibrous masses" of crocidolite (blue asbestos) resemble in structure, not ordinary amphibole asbestos, but serpentine asbestos (chrysotile, better referred to by its older name, karystiolite). Again, it is not much use giving the value of precious stones per carat without specifying the size.

(2) Dr. Murdoch's book, on the other hand, is intended as a guide to students who wish to study the structure and composition of the opaque metallic ores in the laboratory, by examining the polished surface under the microscope. There is a useful introduction describing the methods employed and the results that can be obtained, followed by tables for identification. The first classification is by colour, the next by hardness, and the third by the behaviour with reagents. Königsberger's earlier method of observing the optical characters of opaque minerals in polarised light is described, but not his later method (*Centralblatt für Min.*, etc., 1909, p. 245), which promises to be of more general utility.

J. W. E.

OUR BOOKSHELF.

A Manual of Field Astronomy. By Andrew H. Holt. Pp. x+128. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 6s. net.

THIS is a handy and lucid manual dealing with all the problems that arise in field work with a theodolite, namely, determinations of altitude, latitude, azimuth, time, and longitude. It contains a useful list of formulæ for obtaining any element of the astronomical triangle in which three elements are supposed to be known. Attention may be directed to the unusual notation; the polar distance, zenith distance, and colatitude are called z, p, and s respectively; this is because they are opposite the points Z, the zenith, P, the pole, and S, the star. The explanations refer throughout to the American Ephemeris, but the arrangement of the British Nautical Almanac is so similar that they will serve equally for it. All needful corrections, such as parallax and refraction, are explained, but the author deliberately refrains from introducing refinements that are of no importance for work in the field. It is evident from a study of the examples that the degree of accuracy contemplated by the author is only of the order of the nearest 10″. A considerably higher degree of accuracy is attainable with field instruments of the finest type, but the methods explained in the book will suffice, if carefully followed, to give this greater refinement.

An appendix explains the use of the "solar attachment," which is designed to solve the astronomical triangle mechanically, and give a direct determination of the meridian from an observation of the sun at any time. The accuracy attainable with it is stated to be not much greater than the nearest minute of arc.

ANDREW C. D. CROMMELIN.

Stanford's Half-inch Map of the Battle Front in France and Flanders: Ostend, Zeebrugge, Bruges. War Map No. 23. (London: E. Stanford, Ltd., 1917.) Price 2s. 6d.

THIS sheet is a continuation northward of the map of the British battle front in France and Flanders previously published by the same firm. It extends from Dunkirk in the west to within six miles of Flushing in the east, and southward to the latitude of Roulers, and so comprises the greater part of the plain of Flanders. There is little high ground in this region, and the only contour shown is that of 125 ft. All the ground above that height is stippled light red. The method is successful so far as this sheet goes but on higher ground done on a uniform method the depth of colour would obscure the map. There are no spot heights, but they are scarcely required in Flanders. Woods, lakes, and marshes are shown by conventional signs without colouring. Roads, railways, and canals are clearly marked. As regards roads, apparently there is a differentiation into main-roads, by-roads, and tracks. This, however, is not stated in the explanation. There are sufficient names, but crowding has been avoided. The British front in June is shown by a red line. It is a clearly printed and useful map with a great amount of detail, and allows the progress of operations, both on the Belgian front and along the coast, to be closely followed.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

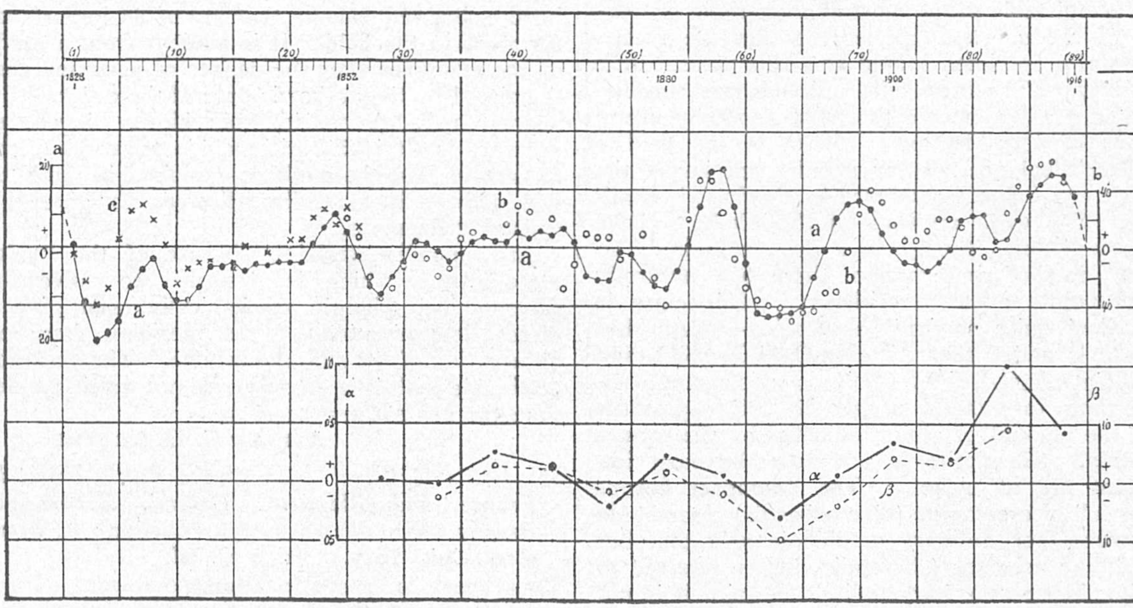
A Forecast of Coming Winters.

A STATISTICAL examination of ancient records of winter temperatures in Western and Western-Middle Europe led me to the conclusion, in 1904 and 1905, that periodicities of 44½ and 89 years have the greatest influence on the occurrence of mild and severe winters in this part of the world. These periodicities, undoubtedly related to similar fluctuations in the sun's activity, are especially manifest in lower winter temperatures at the beginning, and in higher winter temperatures in the latter part, of the periods. Thus, in the 89-year period 1828–1916, the winter temperature is generally lower in the first and third 22-year interval, and comparatively high in the second and fourth; the interval 1828–49 being the coldest, the interval 1895–1916 the warmest part of the whole period. Not only the monthly means, but also the frequency of mild and severe winters, show this periodicity.

So early as 1905 I pointed out[1] that a series of warm winters might be expected in the following years, according to these statistics, and that the year 1917 marked the beginning of a new period of *comparatively* cold winters. Though it seems a matter of mere chance that exactly the winter 1916–17 turned out to be the first cold winter after so many mild winters as we experienced since the beginning of this century, the first really cold winter since 1895 in W. Europe; nevertheless, a change in the weather-type about this time is in perfect agreement with the forecast.

Since the publication of my first paper on this subject I have been collecting and critically examining all materials on winter temperature that are available on the Continent and in England, in order to trace the *vera causa* that must lie hidden behind such a period or complex of periods. I did not, however, succeed; even the Fourier analysis, applied to these data with the kind assistance of Dr. Van der Stok at the R. Institution of Meteorology, in De Bilt, failed to give a clue.

There remained, however, a means of testing the reality of the suspected 45-year or 89-year periodicity. If this periodicity were real, the curve representing the thermometrical observations, made during the latter half of the nineteenth century, at some representative stations in W. Europe, *e.g.* Paris and Utrecht (De Bilt), should fit in with the 89-year curve derived from the "historical data." The result of such a comparison can be seen in the diagram, where



89-year periodicity of winter-temperature in W. Europe. "a" and α (full-drawn lines), historical; "b," "c" β, instrumental data.

the full-drawn line "a" gives the "historical" 89-year curve, "b" (dotted) the "thermometrical" curve since 1852, the crosses marked "c" having been added in order to trace back the instrumental records to the year 1828, although this part of the curve had to be taken from less trustworthy data. All this applies only to the western part of Europe. The curves α and β represent the same data since 1852, simplified and smoothed. Making allowance for a certain shifting of the phase in the latter part of the curve, the dips and crests show, I think, so much analogy as to preclude a purely accidental conformity of the two curves, compiled from absolutely different data.

Want of space compels me to refer the reader to my paper, just issued by the Amsterdam Academy of Sciences.[2] I must now confine myself to give a table showing the frequency of cold and severe winters in periods of 22 (22⅛) years since A.D. 760; period

[1] "Oscillations of the Solar Activity and the Climate" (Proc. Roy. Acad. Sci., Amsterdam, vols. vii.–viii., 1904–5).

[2] "Periodicity of Winter Temperatures in Western Europe since the Year 760" (Proc. Roy. Acad. Sci., Amsterdam, vol. xxv., 1917).

No. XIII. thus running from 1828 to 1916. The deficiency of severe winters in the last column is striking.

Frequency of (a) *Cold,* (b) *Severe Winters,* 760–1916.

89-year Period	Period-year 1–22		Period-year 23–45		Period-year 45–67		Period-year 68–89	
No.	Cold	Severe	Cold	Severe	Cold	Severe	Cold	Severe
I.	1	(1)	0	(0)	1	(1)	0	(0)
II.	1	(1)	1	(1)	2	(1)	2	(0)
III.	2	(1)	1	(0)	3	(1)	1	(0)
IV.	3	(1)	2	(0)	2	(2)	1	(0)
V.	3	(1)	2	(1)	2	(1)	0	(0)
VI.	5	(2)	1	(1)	3	(1)	1	(0)
VII.	2	(1)	3	(1)	2	(0)	1	(1)
VIII.	3	(0)	2	(1)	3	(2)	2	(1)
IX.	1	(0)	2	(1)	2	(0)	1	(0)
X.	2	(1)	2	(0)	2	(2)	0	(0)
XI.	4	(1)	1	(1)	3	(1)	0	(0)
XII.	1	(1)	3	(0)	4	(3)	1	(0)
XIII.	2	(1)	2	(0)	2	(2)	1	(0)
VIII.–XIII.	2·2	(0·7)	2·0	(0·5)	2·7	(1·7)	0·8	(0·2)
I.–XIII.	2·3	(0·9)	1·7	(0·5)	2·4	(1·3)	0·8	(0·2)

The conclusions of the whole investigation may be summarised as follows (all this relates, of course, to winter temperatures in W. Europe):—

(1) Within each interval of $44\frac{1}{2}$ years (759·5–803·0 . . . 1872·0–1916·5), the first half is colder than the second.

[The difference in the amount of temperature-deviation has been found on an average 20° per 44 winters; after the year 1383 on an average 26°.

Exceptions, or apparent exceptions, from this rule, two out of twenty-six cases since 760, none since 1200.]

(2) Within each interval of 89 years, to begin with the year 759·5 (1827·5), the first half is colder than the second.

[The difference in the amount of temperature-deviation has been found on an average 22° per 89 winters.

Exceptions from the rule, two out of thirteen cases since 760, besides two doubtful ones; since 1116 one exception.]

(3) The chance that the last quarter of an 89-year period (826·25–848·5 . . . 1894·25–1916·5) contains a smaller number of hard winters than the preceding and following 22-year intervals is 0·88. Within the last quarter of an 89-year period the chance that any winter will be severe (or very severe) is less than 0·4 (or 0·007), *i.e.* less than $\frac{1}{2}$ ($\frac{1}{5}$) of the general chance. In the neighbouring 22-year intervals (*e.g.* 1872–93 and 1916–37) this chance is about three (five) times as great.

(4) Increased and accelerated activity of the solar surface corresponds in general with the winter-cold in Western Europe setting in more forcibly and quickly than usual; inversely, a weakened and retarded activity of the sun corresponds with winters setting in more mildly and in a later part of the period.

The forecast for the period 1917–38, derived from these statistics, indicates at least two very cold and one severe winter; the average winter temperature for these twenty-two years being generally below the 89-year mean.

C. EASTON.

Amsterdam, June, 1917.

Auroras and Magnetic Storms.

WITH reference to your note in NATURE of August 16 referring to a magnetic storm on the night of August 9–10, it may be of interest to learn that an aurora was seen here that night. It was first seen a few minutes before 10 p.m. (G.M.T.), when it appeared as a glow in the northern sky. Two streamers were just discernible at first, but they gradually increased in numbers and became clearer, at the same time growing longer and brighter and moving towards the west. The longest reached to the centre of the Great Bear. Small, sharp, and delicate streamers, although not prominent, were distinctly seen in the larger streamers. There was no colouring seen at all, but merely a white glow. By 11.15 all traces of it had vanished.

L. CAVE.

Testing Squadron, Royal Flying Corps,
Martlesham Heath, Suffolk, August 21.

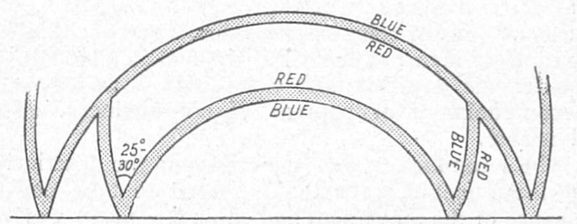
An Unusual Rainbow.

AN unusual rainbow display was visible at sea between 6.30 and 7 p.m. on the evening of August 16. The primary and secondary bows were complete and of exceptional brilliancy. Between these two lay two arcs of a third bow, cutting the primary bow near the horizon and ending in the secondary bow about 20° above the horizon in the manner shown in the accompanying diagram.

The blue of this bow was towards the primary bow, and the red towards the secondary bow. This third bow cut the primary bow at an angle of 25°–30°.

Outside the secondary bow were visible two arcs of a fourth bow (less distinct than the others) which cut the secondary bow in much the same way as the third cut the primary.

Unfortunately, I am unable to give you at present



the ship's position at the time when the phenomenon was seen. The sun's altitude was about 7° when the bows were most clearly seen. The afternoon was warm and sultry and there was practically no wind. A thunderstorm took place at some distance from the ship during the afternoon.

I shall be glad if any of the readers of NATURE can give me an explanation of the phenomenon, which has caused considerable discussion among the officers of the ship.

ALLAN J. LOW.

August 16.

An Invasion of Ants.

YESTERDAY afternoon (Bank holiday) the weather suddenly became brilliantly sunny and very hot, after some days of gloom with rain and thick east wind atmosphere; and about five o'clock I became aware that apparently every ants' nest in the garden had chosen that precise moment for the emergence of its winged inhabitants. There they were in myriads, swarming out of holes in the drive, gravel paths, flagstones, the rock-garden, where they had been devastating Sempervivum clumps, and all over the lawns. They were nearly all the small red ant, only a few nests of the small black one.

The tiny winged males much outnumbered the large-bodied winged females, and both were attended by fussily anxious "workers"; by seven o'clock all were gone. Can ants delay their appearance above ground until the onset of suitable hot, dry weather?

ELEONORA ARMITAGE.

Dadnor, Herefordshire, August 7.

THE appearance in swarms of male and female ants for the nuptial flight is described by many observers.

References will be found, for example, in Mr. H. K. Donisthorpe's recent book on "British Ants" to the species *Myrmica rubra* and *Lasius niger,* which are probably those noticed by Miss Armitage. Her observation is of interest in showing how the workers direct the exodus of the winged forms when weather conditions become favourable.—EDITOR.

THE ADOPTION OF THE METRIC SYSTEM.

THE controversy with reference to the metric system appears to have passed through two stages and to be approaching the climax of its third, and possibly final, stage. In the first stage the glamour of its uniformly applied denary scale, and of its carefully related standards of length, area, volume, and weight, carried the general public in an apparently wholehearted advocacy which was clearly reflected in the early divisions on the Metric Bill in Parliament. Advocates of the binary scale might attend metric meetings and tear up sheets of paper into two, four, and eight parts; theorists with the duo-denary scale might drag a red-herring across the trail; workers with the most convenient of the English weights and measures might voice their fears of a bad exchange in units of measurement; but the metric advocates carried the day, in most cases with a wonderful accompaniment of popular, if not business, enthusiasm.

The second stage was reached when the practical business men were actually forced to take cognisance of the movement and either accept, or work vigorously against, it. The natural thing happened—how could it be expected that British controllers of industry—industry inductively developed—should be other than short-sighted and insular in their ideas? The nation which deliberately attempted to cut itself off from the Continent in the sixteenth century by adopting a different Latin pronunciation was not likely in the nineteenth to be ready to accept at once any Continental standard, even in weights and measures. Every conceivable objection was raised—and it is perhaps as well that this was so; for we now understand much more clearly the "pros and cons" of the case.

Possibly the greatest difficulty, which has still to be overcome, is the inborn tendency not only of British, but also of all traders to vary their trading conditions. "Tare and *tret*" accounts have only just vanished from our book-keeping—37 inches are still allowed to the yard; there are several pounds; apparently a stone may be 8 lb., 14 lb., or 16 lb.; a hundred may be a hundred, or a hundred and twelve, or a hundred and twenty (a great hundred) units; while we have also such things as "strikes," "bags," "boxes," etc., of very questionable contents. Such variations tend to promote that "opportunism" which is at daggers drawn with the wider and more humane view of commerce. The tendency to perpetuate this heterogeneity is not only British; it is international, and is undoubtedly one of the weaknesses which mankind as a whole must face and fight if larger opportunities for international service are to be won.

This inherent tendency explains why even among metric nations the metric system has not always conserved its pure form, and why among non-metric nations the metric system has not been introduced even into recently developed industries. Man has to fight against himself, or rather against certain of his intuitive tendencies, to become the controller of his own environment. Thus, when Mr. W. R. Ingalls, in his paper read before the Institution of Mining and Metallurgy on May 24, confesses to thinking more clearly in the pound than in the kilogram, the present writer is reminded of how for years his personal unit of weight was the 8-lb. to 9-lb. hare which he carried when accompanying certain of his relatives on their shooting expeditions. The suggestion undoubtedly is that the sooner we definitely teach our young people to work and think in carefully standardised units, instead of allowing them to adopt units accidentally coming within their cognisance, the better for us as a nation and for the world in the broadest sense. Have we yet realised the advantages of deliberate intent, as distinct from casual drift, in this and other similar problems which we must face?

We are now in the third stage, in which the objections to the denary scale and the metric units have practically disappeared. Thus the two problems which to-day are being seriously debated are:

(1) If the metric system is the only possible system that may be universally adopted, will the expense entailed in its adoption by non-metric countries be more than balanced by the advantages gained in the reasonably immediate future?

(2) If it is desirable to adopt wholeheartedly the metric system throughout our industries, how may this best be effected with reference to both our working staffs and the material means by which metric measurements may be made?

With reference to the first proposition, there is no need to discuss the possibility of the universal adoption of the British system rather than the metric system, for two reasons. The first is that there is no British system. Take the textile industries as an example. The Bradford manufacturer speaks a more difficult textile language to the Leeds manufacturer than the Continental manufacturer employing the metric system; and instances might be multiplied. Again, the most standardised of all the British systems—the avoirdupois—scarcely bears signs of its British origin on its face. The second reason is that year by year, month by month, and almost week by week, our industries are being more and more controlled from their laboratories—and all scientific laboratories adopt the metric system. What confusion and mistakes there will ultimately be unless uniformity is here enforced!

Looking at the problem from the broadest basis, Mr. Ingalls' paper is a delightfully unconscious portrayal of the typical British (or American) attitude of mind. We must make our drawings in our own units, and if the French want them they must re-draw them. If Russia, China, and South America want British or American productions, they must buy them in our sizes. But surely we have attained a broader outlook than this? If not, the future for our industries is not of the brightest. Will Japan, for example, follow such a lead or take the broader view?

Granted, then, that the metric is now the only possible universal system, will it pay Britain and the United States to adopt it? The answer to this question entails the consideration, in the first place, of what the expenses are likely to be, and, in the second, of what return may reasonably be expected. In the paper already referred to, and particularly in an article on "The Metric System: Its Meaning for the Machine Shop," appearing in the *Times Engineering Supplement* of May 25, the expenditure that would be entailed in making the proposed change is advanced as the main and most potent reason against the proposal. This argument is exactly that which advocates for the change would expect and wish to answer. The question is now brought down, or rather elevated, to a practical issue which those who are for and those who are against must seriously face. Action must be taken one way or the other, and a decision on this particular, and possibly dominant, issue may readily be arrived at. Instead of the writer in question quoting only capital expenditure on gear cutters, drills and reamers, screwing tackle, measuring instruments, machine tools and gears, let him also supply a trading account—a yearly turnover account—based upon a standard plant on which the expenses of the proposed change may also be arrived at. Here is a simple one taken from the textile industries (a worsted drawing plant):—

	£
Total cost of installation	1,120
Annual depreciation—allowance at $7\frac{1}{2}$ per cent. per annum	84
Turnover of raw material	56,250

From this it must be evident that two of our greatest industries, cotton and wool, have much more serious questions to face than capital charges; and in these days, when we do not hesitate to spend 9,000,000*l*. a day on the war, there must be something more than a mere statement of expenses, however small or however great, if such an objection as that advanced by the writer in the *Times Engineering Supplement* is to be seriously considered. There must be a careful balancing up, with all the disadvantages and the advantages in full view. The writer can state, without hesitation from personal experience, that at least in certain of our industries not only would there be a prospect of recuperating from the inevitable expenditure within a reasonable limit of time, but also that from the day the metric system was adopted there would be a credit side to the account.

If, then, it be granted that it is desirable wholeheartedly to adopt the metric system, the practical means of carrying this into effect should immediately be thought out and the train laid and fired. Here is straight away a splendid use for our schools and colleges. The task that will be set them is one which, if their teaching staffs will rise to the occasion, will revitalise mathematical knowledge, introducing inspiration in the place of the too often orthodox deadness and stimulating both the teacher and pupil. The task of supplying the necessary weights and measures might well be left in the hands of those who would first instruct, and then organise into an active force, the more capable of our men returning from the front on the declaration of peace. What an opportunity for organising and carrying into effect a movement that would be a credit even to a nation which has so valiantly helped to withstand, at all too short a notice, the onslaught of the greatest military force the world has ever seen.

The alternative to the compulsory adoption of the metric system throughout our industries at once is its gradual introduction trade by trade; but of the alternatives we prefer the former. Already certain manufacturers are prepared to run their factories on the metric system, and are only deterred from so doing by the necessity of training every fresh hand that enters their establishment from non-metric factories. With this difficulty removed by suitable legislation, the advantage is most markedly on the side of the metric system. At least, this is the firm opinion of those who have worked under both systems in British and Continental workshops and factories.

A. F. B.

PROF. W. B. CLARKE.

The death of William Bullock Clarke on July 27 deprived Maryland of one of its most distinguished men of science. He came of an old New England family, his ancestors having crossed in the "Mayflower." He was born in Vermont in 1860, and after taking a degree at Amhurst College studied at Munich from 1884–87, where he obtained the degree of Ph.D. He returned the same year to Baltimore to the post of geological instructor at Johns Hopkins University, and in 1894 became professor and head of the Department of Geology there. He used his vacations and spare time in working for the Geological Survey of the United States, on the regular staff of which he remained until 1907. Most of his work for the survey was on the Cretaceous and Kainozoic rocks of the coast district, and he helped in the geological survey of the country around Philadelphia and Trenton.

His most important single piece of research is probably his bulletin on the Mesozoic echinoids of the United States. He was, however, led from research by his skill as an organiser. In 1892 he founded the Maryland State Weather Service, of which he remained director until his death. In 1896 he established the Maryland Geological Survey and became State geologist. Under his direction the State Survey issued a series of geological reports which are notable both for their breadth of view and their unusually excellent form. As State geologist he was responsible for the Road Service, on which, before its separation as an independent department, he was responsible for the expenditure of more than two million dollars. He was also entrusted with the representation of Maryland on the re-survey of the boundary between that State and Pennsylvania. He was executive officer of the Maryland Forestry Board, and took an active share in the replanning of Baltimore after the great fire in 1904. Meanwhile he had been continuously active in the development of the mineral resources of Maryland and in various spheres of educational and philanthropic work.

His death will be deplored in this country by many friends who knew the charm of his personality and by the still wider circle who knew of his success in scientific administration.

NOTES.

Two new orders have been instituted by the King in recognition of services rendered by British subjects and their Allies in connection with the war, viz. the Order of the British Empire and the Order of the Companions of Honour. The Order of the British Empire has five classes, viz.:—*Men*: (1) Knights Grand Cross (G.B.E.); (2) Knights Commanders (K.B.E.); (3) Commanders (C.B.E.); (4) Officers (O.B.E.); (5) Members (M.B.E.). *Women*: (1) Dames Grand Cross (G.B.E.); (2) Dames Commanders (D.B.E.); (3) Commanders (C.B.E.); (4) Officers (O.B.E.); (5) Members (M.B.E.). The first two classes, in the case of men, carry the honour of knighthood, and in the case of women the privilege of prefixing the title "Dame" to their names. The first lists of appointments to the orders have just been issued, and among those named we notice the following:—To the Order of the British Empire: Lord Moulton and Lord Sydenham (G.B.E.); Mr. Dugald Clerk, Prof. H. S. Jackson, and Mr. R. Threlfall (K.B.E.); Dr. Garrett Anderson, Prof. H. B. Baker, Mr. L. Bairstow, Prof. W. H. Bragg, Prof. S. J. Chapman, Mr. W. Duddell, Mr. F. W. Harbord, Prof. F. W. Keeble, Dr. Mary A. D. Scharlieb, and Prof. J. F. Thorpe (C.B.E.); Prof. J. C. McLennan (O.B.E.). The following have, among others, been appointed Companions of Honour: The Hon. E. Strutt and Prof. Ripper.

A COMMITTEE to inquire into various matters connected with the *personnel* and administration of the Army medical services has been appointed by the Secretary of State for War. The committee is composed of Major-General Sir F. Howard (chairman), Sir Rickman J. Godlee, Bart., Sir Frederick Taylor, Bart., Sir W. Watson-Cheyne, Bart., Dr. Norman Walker, Lieut.-Col. A. J. Stiles, Dr. Buttar, and Dr. J. B. Christopherson (secretary). It will begin its work in France, and afterwards carry out similar investigations in this country.

WE regret to see the announcement of the death, at the age of seventy years, of Major A. N. Leeds, the palæontologist, which occurred on Saturday last.

THE death is announced, at the age of seventy-three years, of Mr. Donald Maclennan, well known as a breeder of pedigree stock.

WE regret to record the death of Mr. Walter E. Archer, which occurred suddenly on August 19 at Sand, Norway, at the age of sixty-two. Mr. Archer was successively Inspector of Salmon Fisheries for Scotland (1892–98), Chief Inspector of Fisheries under the Board of Trade (1898–1903), and Assistant Secretary in charge of the Fisheries Department of the Board of Agriculture and Fisheries (1903–12). When in Scotland Mr. Archer, in association with Prof. Noel Paton, Mr. J. R. Tosh, and others, instituted a series of investigations on the salmon, which helped to elucidate a number of points which were still obscure in the life-history of that fish. In London Mr. Archer devoted great attention to the development of a more efficient system for the collection and subsequent study of the statistics of English sea fisheries, and the very valuable work in that direction now done by the Board of Agriculture and Fisheries is chiefly due to his initiative. He was for a number of years a British delegate to the International Council for the Investigation of the Sea, and president of that body from 1909 to 1912.

THE science staff at Christ's Hospital has again suffered severely from the war by the death on active service of Lieut.-Col. T. H. Boardman, who died of wounds on August 4. Col. Boardman joined the school when it was removed to Horsham in 1902, and was one of the four masters appointed to establish and develop a science department under the new conditions. His previous experience as science master at Blair Lodge, following a brilliant career at Bury Grammar School and at Peterhouse, Cambridge, was invaluable in the pioneer work of winning for science a footing in a public school of classical traditions. Adopting essentially the heuristic method, he proved himself to be a teacher of the highest order, with a power of control and organisation that contributed in no small degree to the success and popularity of the new department. Although he was co-editor with Mr. Wm. French in a school text-book on chemistry, physics was his special *forte*, and before he left to take up his commission as Major in the Royal Fusiliers on the outbreak of war, he had brought his laboratory to a high state of efficiency. Originality and thoroughness were stamped on everything he undertook, and many were the ingenious devices he invented for illustrating the principles of the various branches of physics dealt with. For many years he carried out with some of his classes an interesting scheme of agricultural experiments, the results of which he utilised as a basis for much useful work in the laboratory. "A hero and a gentleman," one of his officers writes of him, loved and respected by all who knew him, his willing sacrifice for King and country is a loss to the school immeasurable, and to his wide circle of friends a sorrow beyond expression.

THE death is announced, in his forty-sixth year, of Prof. Albert F. Ganz, holder of the chair of electrical engineering since 1902 at the Stevens Institute of Technology, Hoboken, N.J. Prof. Ganz had previously held the post of assistant professor of physics and applied electricity at the same institution. He had specialised in electric lighting and in the investigation of the corrosion of underground structures by electrolysis, on which subjects he had contributed largely to American technical journals.

DONATIONS and promises towards the Ramsay Memorial Fund received by the honorary treasurers amount so far to 21,352*l*., including 835*l*. from members of the British Science Guild; 500*l*. from Sir George Beilby, and 100*l*. each from Lord Rosebery, the Company of Clothworkers, and the Salt Union, Ltd. Prof. Orme Masson, of the University of Melbourne, has undertaken to act as the representative and corresponding member of the committee for Australia. As already announced, Prof. C. Baskerville, of the College of the City of New York, is acting in a similar capacity for the United States.

SEVERAL letters on the sound of gunfiring have appeared in the *Times* (August 22, 24, and 25), following the interesting letter by Mr. G. F. Sleggs, the greater part of which was reprinted in our last issue (p. 513). The recent letters deal with the transmission of the sound-waves by the earth, though the inferences are not always correct, as, for instance, when it is argued that the sound must travel through the ground because it is heard more plainly when the wind is contrary. At Rusthall (near Tunbridge Wells), a gravedigger, who was digging a deep grave, stated that the sound of the firing at the bottom was much louder than on the surface. A lady, lying on the top of Blackdown Hill, in Sussex, heard the heavy bombardment of June 24, but, when sitting up, heard nothing. Another writer recalls an incident of the battle of Waterloo. Marshal Grouchy and several of his staff were at Sart-les-Walhain when an officer reported that firing was heard to the west. "Some of them placed their ears to the ground and thus detected plainly the muffled boom of distant guns."

AN account of a remarkable lightning display was given in the *Morning Post* of August 24, the occurrence happening between sunset and midnight of August 22. The phenomenon was witnessed in London. On the afternoon of August 22 heavy clouds had gathered, and these were dissipated by sundown, when the sky became clear, except that there was a narrow belt of cloud low down on the horizon from north-east through east to south. Near the belt of cloud on the horizon there were at short intervals what are described as vast bursts of flame thrown up into the atmosphere, and at times a flash of ramified, or zigzag, lightning would shoot up far above the cloud. The whole surrounding country seemed illuminated. The source of the flares appeared to be in the vicinity of the east and south-east coasts, and was erroneously attributed by many to war operations. No thunder accompanied the lightning, but thunder cannot be heard for more than ten miles, although lightning is visible ten times that distance and more. Recent weather has been very disturbed, frequent storm areas have traversed England, and thunderstorms have occurred very commonly in many parts of the country, accompanied by strong winds and rain.

REFERENCE was made in our issue of June 21 to the systematic collection of horse-chestnuts for war purposes. A scheme for such collection and utilisation for munition purposes has now been approved, and a circular upon the subject is being sent to local education authorities and secondary schools saying that the Board of Education has been requested by the Minister of Munitions and the Food Controller to bring the scheme to the notice of school authorities, governing bodies, and teachers, and to request their assistance in giving effect to it. It is felt that school children could give most valuable assistance in collecting the chestnuts, and by so doing make a definite contribution to national efficiency. It is suggested, therefore, that the governing bodies, managers, and teachers of schools should organise the efforts of the children for the purpose. To effect this a small committee might be formed in connection with each school or convenient group of schools to undertake the organising work in connection with the scheme in the district concerned, and to answer inquiries. It is understood that in many districts the scheme has already been taken up by private individuals, and it is obviously desirable that all persons undertaking work in connection with the scheme should co-operate with one another. A limited number of sacks and baskets are available for the collection of the nuts, and where there is any difficulty in obtaining bags or baskets locally application should be made to the Director of Propellant Supplies, Ministry of Munitions, 32 Old Queen Street, London, S.W.1. When the collection is complete the committee should inform the Director of Propellant Supplies, as above, stating the estimated quantity of the collection, and the Ministry of Munitions will arrange to remove the nuts and forward them to the factories in the course of the winter.

THE autumn meeting of the Institute of Metals will be held on Wednesday, September 19, in the rooms of the Chemical Society, Burlington House. The following communications are expected:—Experiments on the fatigue of brasses, Dr. B. P. Haigh; Hardness and hardening, Prof. T. Turner; The effects of heat at various temperatures on the rate of softening of cold-rolled aluminium sheet, Prof. H. C. H. Carpenter and L. Taverner; A comparison screen for brass, O. W. Ellis; Further notes on a high-temperature thermostat, J. L. Haughton and D. Hanson; Principles and methods of a new system of gas-firing, A. C. Ionides; Fuel economy in brass-melting furnaces, L. C. Harvey, with additional notes by H. J. Yates; The effect of great hydrostatic pressure on the physical properties of metals, Prof. Z. Jeffries; The use of chromic acid and hydrogen peroxide as an etching agent, S. W. Miller.

THE autumn meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, on September 20 and 21, when the following papers will be read:—"Present Practice in Briquetting of Iron Ores," G. Barrett and T. B. Rogerson; "Microstructure of Commercially Pure Iron between Ar_3 and Ar_2," W. J. Brooke and F. F. Hunting; "The Influence of Heat Treatment on the Electrical and Thermal Resistivity and Thermo-electric Potential of some Steels," E. D. Campbell and W. C. Dowd; "New Impact Testing Experiments," G. Charpy and A. Cornu-Thenard; "Heat Treatment of Grey Cast Iron" J. E. Hurst; "Effect of Mass on Heat Treatment," E. F. Law; "Investigation upon a Cast of Acid Open-hearth Steel," T. D. Morgans and F. Rogers; "The Acid Open-hearth Process," F. Rogers; "The Eggertz Test for Combined Carbon in Steel," J. H. Whiteley; "Failure of Boiler Plates in Service and Investigation of Stresses occurring in Riveted Joints," E. B. Wolff.

THE University of Pennsylvania has issued as vol. vii., No. 1, of the series of anthropological publications an account of the excavation of the cemetery of Pachyamnos, Crete, by Mr. R. B. Seager. This place lies on the isthmus of Hierapetra, in the eastern part of the island, and apparently owed its importance to the use of the isthmus as a trade route. The cemetery was accidentally disclosed after a torrential rainstorm in October, 1913. It seems to have continued in use from very early times down to the Late Minoan period. A notable feature in the interments is the utter disregard shown by the Minoans to the graves of their ancestors, the older graves being constantly disturbed by later burials. The corpse usually lies in the jar in a sitting position; there is evidence to show that the body was deposited in the jar with the head downwards, and the jar was then fixed in the ground bottom up, so that it occupied a sitting or crouching position. The jars are usually of small dimensions, and in some cases it would seem that the hip- and collar-bones were broken in order to force the body into the jar; in other cases it is suspected that the bodies were trussed up immediately after death, or even before death had actually taken place. The lack of reverence for the dead is also shown by the fact that the best jars were not given for use in burial, and if a household happened to possess a damaged specimen it was considered good enough to serve as a coffin.

MANY investigations have been made during the last few years on the nature of the microbe of typhus fever. Several bacterial organisms have been isolated in the disease, notably one by Plotz in America a year or two ago, but none has been satisfactorily proved to be the causative organism. It is now announced that Prof. Kenzo Futaki, of Tokio, has discovered the presence of a spirochæta, a protozoon organism, both in the kidney of patients dead of the disease and in monkeys artificially infected with the disease.

THE tenth report on plague investigations in India has been issued by the advisory committee as Plague Supplement v. of the *Journal of Hygiene* (vol. xv.). It contains epidemiological observations on plague in the United Provinces of Agra and Oudh during 1911–12 by Majors Gloster and White, I.M.S. They find that an association of unusual humidity during the winter months in certain districts with severe epidemics of plague is so constant a phenomenon that they feel justified in concluding that one stands to the other as cause to effect. They believe that this relationship is due to the effect of humidity in prolonging the life of rat fleas when separated from their host. Dr. St. John Brooks in another paper finds that plague does not maintain itself in epidemic form when the temperature rises above 80° F. accompanied by a saturation deficiency of more than 0·30 in.

WE have received a letter from Mr. S. Mahdihassan, of Bangalore, commenting on Dr. Hankin's letter on "Ten per cent. Agar-Agar Jelly" which appeared in the issue of NATURE for March 8 last. Mr. Mahdihassan has found exceptional difficulty in sectioning chitinous tissues at the high temperature of the plains of India by the paraffin or any other method, and considers Dr. Hankin's method will prove a boon. He is not clear why large wings of insects should be embedded in agar when celluloid is to be preferred for smaller wings. Presumably small wings *can* be embedded in celluloid, whereas larger wings cannot, hence the value of the agar-agar jelly method for the latter.

IN the *British Medical Journal* for July 28, Sir Patrick Manson gives an admirable summary relating to British contributions to tropical medicine dealing with protozoa, helminths, and beri-beri. In the same number Major McCarrison, I.M.S., details Indian contributions to the advancement of medicine. A somewhat similar summary dealing with the scientific and administrative achievements of the Medical Corps of the United States Army, by Lieut.-Col. McCulloch, appears in the *Scientific Monthly* for May. All these papers give useful surveys of progress in the departments of medicine with which they deal.

IN a paper on "The Probable Error of a Mendelian Class-Frequency" (*American Naturalist*, vol. li., 1917, pp. 144–56), Dr. Raymond Pearl presents a method of calculating and expressing the errors, due to random sampling, of a Mendelian class-frequency. The method consists essentially in expressing each *expected* Mendelian class-frequency as the probable quartile limit for that class-frequency in a supposed second sample of the same size as the observed sample drawn from the same population. These quartile limits are determined from the ordinates of a hypergeometric series. Various simplifications of method are suggested and illustrated, and the method is put forward as a supplement to, not as a substitute for, the "chi-squared" test for the goodness of fit in Mendelian distributions.

THE *American Museum Journal* for May contains an extremely interesting account, by the late Mr. Joseph H. Choate, of the origin and development of the great Natural History Museum of New York, which depended in its early days entirely on the munificence of the more wealthy of its trustees. When it became apparent that it would be quite impossible to build up by private means alone a museum worthy to compete with the museums of Europe, it was decided to appeal to the Legislature for assistance. Immediately a site of eighteen acres in Manhattan Square was granted, and on this the present building was erected. It was opened in 1877. From this date it grew with incredible speed to occupy the position of one of the world's greatest museums. To this number also Col. Theodore Roosevelt contributes some brief but most valuable notes on the loggerhead and green turtles, which, it seems, are commonly attacked and eaten by sharks in the waters of Florida, while Dr. Clyde Fisher contributes a short account of the methods employed in the capture of the "gopher tortoise" in Florida, where it is eaten in large numbers.

DR. COLIN MACKENZIE, in the *Journal of Anatomy* (vol. li., part 3), records the results of his studies on the peritoneum and intestinal tract in Monotremes and Marsupials. His researches have failed to discover in any of the mammalia up to the great Anthropoids the presence of the so-called Jackson's membrane, Lane's band, or Treitz's band, and he therefore concludes that these must be regarded in man as adaptations to the erect posture. He also suggests a revision of the nomenclature now employed in describing the various regions of the human colon. His use of the terms "acquired" and "biological" instead of "adaptive" and "ancestral" is, to say the least, curious.

THE report of the Education Branch of the Board of Agriculture and Fisheries for the year 1915–16 is published in the July issue of the *Journal of the Board of Agriculture*, with a note that owing to conditions due to the war the customary separate issue is suspended. The report affords gratifying evidence that, despite the severe restrictions imposed by the war upon the development of agricultural education and research, much useful work was accomplished during the year under review. It is not surprising to find a great decrease in the numbers of students taking long courses of instruction, whereas the numbers taking short courses were more than maintained. One notes with regret the necessity for the closing of the Royal Agricultural College, Cirencester, and the Agricultural College, Uckfield, Sussex, and the withdrawal of grants from two other institutions as a measure of war economy. Research work suffered severely owing to the heavy drain upon the staffs for Army or munition purposes, but much useful work on problems of immediate technical importance was accomplished, of which the investigations at Cambridge on wheat-breeding and at Rothamsted on soil and manurial problems may be singled out for special mention.

THE volume dealing with the area, crops, live stock, land revenue, assessment, and transfers of land in British India during 1914–15 has been published by the Department of Statistics, India, under the title of "Agricultural Statistics of India," vol. i., price 4*s*. The area treated embraces nearly a million and a quarter square miles, including feudatory States under the control of local governments. Of the total area about 37 per cent. was under crops during the year, and full details of the acreage of each crop is given, both for the provinces and every district. This valuable statistical volume is enhanced by two appendices, the first giving the vernacular names of the crops, and the second being an alphabetical list of crops, with their scientific nomenclature.

A VALUABLE paper on oil shales and torbanites, by Mr. H. R. J. Conacher, appears in the Transactions of the Geological Society of Glasgow (vol. xvi., part ii., pp. 164–92). These bodies form a group of materials characterised by yielding valuable commercial paraffin oils in distillation, and are, at the present moment, of very considerable importance. Torbanehill mineral, or "boghead coal," has been exhausted for some years, and for oil production the shales of Lothian, Fife, and Linlithgow are relied on. The author deals with the megascopic, but more particularly the microscopic, study, together with a rough comparison of the oil yield and its character. Previous work has led to much difference of opinion as to the constitution and origin of the torbanite and oil shales. Micro-constituents are very varied; they include minute carbonised fragments of plants; yellow bodies, regarded variously as remains of algæ, vegetable spores, or as residues from oil globules; shells of minute crustaceans, teeth and scales of fishes; and a high proportion of mineral matter, parts believed to be pyrites crystals. Boghead coal consists of little beyond the yellow bodies, which, the author concludes, on very good reasoning, are metamorphosed resins, and these yield the characteristic oil products. Interstices are filled with opaque, amorphous matter, similar to that forming the ground mass of coal, and yield products similar to coal-tars, and from this portion the important nitrogenous constituents in shale products are derived. Unhesitatingly the author ascribes these shales and torbanites to vegetable sources. The boghead coal of Linlithgow represents a deposit formed in a swamp fringed with vegetation, but with open water towards the centre sufficiently deep to prohibit the growth of plants. Drifted vegetable matter reaching the central area became so completely oxidised as to leave practically only the resin. The Lothian oil shales accumulated as the widespread mud-flats of an estuary, the river bringing down a proportion of extremely macerated vegetable matter, the ebb and flow of the tide aiding in the elimination of the woody materials and concentration of the resin.

THE Italian Geographical Society continues its series of special publications on the Italian field of operations and the borderlands of Italy. A small volume ("Pagine Geografiche della nostra Guerra") contains six lectures delivered before the society in 1916 on the geography of the war area, the geology of the Trentino, the Adriatic lands of Albania, the Carso, Dalmatia, and the Carnic Alps. The volume is illustrated with several black-and-white maps and one coloured one, which is specially interesting. It is a map of the regions adjoining the present political frontier of Italy in the north-east, and is coloured to show the distribution of races as represented by majorities or minorities of Slavs, Italians, and Germans. The proposed new frontier drawn on this basis shows a close coincidence with the natural physical frontier running along the Alps.

IN the *Scientific American* for July 21 Prof. T. H. Norton describes in simple terms the problems in dye synthesis which are now being undertaken by American chemists. He traces the evolution of synthetic dyes from some seven or eight direct coal-tar products ("coal-tar crudes") through the intricate maze of intermediate products to the finished dyewares. The processes whereby the coal-tar crudes are converted into intermediates are the chemical operations of nitration, reduction, sulphonation, alkali fusion, chlorination, oxidation, and sulphur fusions. These processes, constituting the simpler reactions where inorganic reagents are employed, are now carried out on a very large scale and require highly specialised plant, of which illustrations are given. As a concrete example, the care of the important colour-producing intermediate, "H. acid," is cited. This substance, which has the systematic name of 8-amino-α-naphthol-3 : 6-disulphonic acid to distinguish it from 219 isomerides, is derived from naphthalene. The hydrocarbon is treated with sulphuric acid (sulphonation) and converted into naphthalene-2 : 7-disulphonic acid, one of ten possible isomerides. The product is treated with nitric acid (nitration), when 1 : 8-dinitronaphthalene-2 : 7-disulphonic acid is obtained. The dinitro-compound is reduced with acid and iron filings to 1 : 8-diaminonaphthalene-2 : 7-disulphonic acid, the penultimate intermediate which on heating with dilute sulphuric acid under pressure at 120° C. yields the required H. acid. This highly prized intermediate is greatly needed in the preparation of direct cotton blues and various shades of black, violet, and green. The preliminary work to be done in passing from naphthalene to this intermediate may be gauged by the fact that the raw material costs about 5*d*. per lb., whereas H. acid is quoted nowadays at about 10*s*. per lb.

WE have received a copy of a pamphlet by Mr. Robert N. Tweedy on "Industrial Alcohol," written for, and published by, the Dublin Co-operative Reference Library. Its object is mainly twofold: first, to emphasise the desirability of producing a home-grown liquid fuel, and secondly, to do so to the advantage of agriculture. These two objects are to be fulfilled by the manufacture of potato spirit on a large scale. The author points out that our staple fuel, coal, cannot be used for a variety of industrial purposes, such as the manufacture of chemicals and motor traffic, and that for the latter especially we are dependent on imported petroleum, which is steadily rising in price. In 1914 we imported petrol to the extent of 120 million gallons (imperial), in addition to 150 million gallons of burning oil. The extent to which alcohol is used on the Continent, especially in Germany, for industrial purposes may be judged from the following statistics. Whereas in 1914 a little more than four million gallons of methylated spirit were used in the United Kingdom, in 1912 France produced 87½ million gallons, of which eighteen million gallons were denatured and twelve and a half million gallons were used for heating and lighting. In 1913 Germany produced seventy million gallons from potatoes alone, representing 80 per cent. of the whole production of alcohol, a large proportion of which was used for heating, lighting, and motor traffic. The author lays stress on the fact that denatured alcohol for industrial purposes might be produced with profit from potatoes in the manner that has been developed with so much success in Germany; but that to do this an entire revision of the excise laws will have to be taken in hand. At present it is hedged in with such restrictions that until they are removed or modified there is no prospect of this important branch of agriculture being seriously exploited.

A WRITER in *La Nature* for August 4 discusses the special features which aeroplanes of the chaser and bombardment types should possess for adequately carrying out the work assigned to them. He takes as examples of the two classes the Gotha type—*i.e.* the type which has been prominent in recent air raids over London—and the Albatros. The Gotha type is characterised by extensive plane area, high engine capacity, and its powerful armament. The latest types carry 600 kilos. of bombs. The power necessary is furnished by two motors of 260–280 h.p. each. The planes cover an area of about 100 sq. metres, while the total length of the aeroplane is 12 metres and the span 24 metres. A speed of 140 kilometres per hour can be attained. The Albatros of the D.I. type has a Mercédès engine of 170 h.p., a plane area of about 24 sq. metres, a length of 7 metres, and a span of 9 metres. It has a speed of 200 kilometres an hour. Further interesting details of the construction of these two types of aeroplane are given in the article quoted.

OUR ASTRONOMICAL COLUMN.

COMET 1916*b* (WOLF).—The following is a continuation of Messrs. Crawfurd and Alter's ephemeris of this comet, for Greenwich midnight:—

1917	R.A. h. m. s.	Decl. ° ′ ″	Log Δ	Brightness
Aug. 31	23 40 22	+12 24 23	9·9998	
Sept. 2	40 22	11 34 5	0·0020	2·29
4	40 18	10 43 12	0·0045	
6	40 12	9 51 55	0·0074	2·17
8	40 4	9 0 25	0·0108	
10	39 53	8 8 54	0·0146	2·05
12	39 42	7 17 34	0·0188	
14	39 29	6 26 35	0·0234	1·91
16	39 16	5 36 9	0·0284	
18	39 4	4 46 27	0·0338	1·77
20	38 52	3 57 38	0·0396	
22	38 41	3 9 52	0·0457	1·63
24	38 31	2 23 17	0·0522	
26	38 24	1 38 1	0·0590	1·49
28	38 18	0 54 11	0·0661	
30	38 15	0 11 50	0·0735	1·35

The unit of brightness is that on April 21, 1917. The comet will be at opposition on September 17.

RADIAL VELOCITIES OF SPIRAL NEBULÆ.—In view of the faintness of spiral nebulæ, and the small dispersion necessarily employed in photographing their spectra, some doubt may have been felt as to the reality of the extraordinarily high radial velocities which have been derived for these objects. A recent statement by Dr. V. M. Slipher, however, appears to place the main results beyond question (the *Observatory*, August). The average velocity which he has found for thirty spirals is 570 km. per second, and he points out that this is more than twenty-five times the velocity of an average star. Thus, although the spectrograph employed for nebulæ at the Lowell Observatory has a linear scale only about one-fifteenth that of a powerful three- or four-prism spectrograph, it is at no disadvantage as regards the relative accuracy of the results obtainable in the two cases, when similar precautions have been taken. Further confidence is given by the agreement in the results obtained for the Great Andromeda nebula at four different observatories, namely, velocities of approach of 300, 304, 300–400, and 329 km. per second. These compare very favourably with the values which have been found for stellar velocities by different observers, those for Canopus, for example, ranging from 18·5 to 21·0 km. per second.

THE HISTORY OF ORBIT DEDUCTION.—In an address on "The Derivation of Orbits: Theory and Practice," delivered to the American Mathematical and Astronomical Societies, and published in *Science* of June 8, Prof. A. O. Leuschner deals in an interesting and illuminative manner with the history of orbit deduction from Newton downwards. Prof. Leuschner himself introduced some very useful modifications a few years ago, and his method is now generally acknowledged to be the most rapid and convenient for obtaining preliminary orbits of newly discovered planets or comets. It is based on that of Laplace, using three observed right ascensions and declinations, and their first and second differences. This method fell into discredit owing to some over-hasty strictures of Lagrange; it had the undoubted disadvantage that the first and third observed positions were not exactly satisfied by the resulting orbit. Harzer showed how differential corrections might be applied, and Leuschner introduced further improvements, which are best summarised in his own words. "Criteria have been introduced . . . regarding the eccentricity. Provision has been made for passing from parabola to ellipse without repeating the solution. Numerical criteria have been set up to distinguish the physical from the mathematical solutions. A method has been provided for eliminating the parallax. The various approximations for the distances are avoided; these are taken from a table; the accuracy attainable in each case can be ascertained, and the range of solution determined." These claims are well justified in the numerous orbits that have been published by Prof. Leuschner and his students. The case of planet MT (Albert) was particularly striking. Dr. Haynes obtained an orbit from three observations, at very short intervals, by the aid of which several other places were found on later plates; they were so faint that an approximate knowledge of the position was required before they were detected.

PROGRESS OF APPLIED CHEMISTRY.

THE annual general meeting of the Society of Chemical Industry was held in Birmingham on July 18–20. At the opening meeting the chair was taken by the Lord Mayor of Birmingham, Ald. A. D. Brooks, who, in an address, said the society had two chief objects at present: first, to assist in the prosecution of the war, and, secondly, to do its best to help the country after the war. The war was being carried on largely by scientific methods, and the chemist was devoting his attention chiefly to destroying human life, whereas formerly his efforts had been directed to the elimination of things dangerous to life. Before the war Englishmen had allowed important improvements to pass into other hands, but they must see to it that this did not happen again. Suspended industries must be rebuilt, and all conducted on sound economical lines, using to the full all scientific and technical help. Alluding to Birmingham industries, the Lord Mayor emphasised the need for recovery of waste products and conserving mineral resources.

Dr. Carpenter replied suitably, and proceeded to read his presidential address. He indicated the basis of modern industry in the sciences of mechanics and chemistry, and insisted on the absolute necessity for the engineer and the chemist to "get into double harness as quickly as possible" and work sympathetically together for the progress of the chemical industry.

Each paper given during the congress might be cited as an exemplar of the president's remarks. Each was a record of an effort or efforts of the chemist to co-operate with the engineer, and in this way to further the interests of some industry. For example, Messrs. Hancock and King, in their paper on "The Texture of Fireclays," described methods of comparing the unfired fireclay with the finished material, and the paper by Mr. Henry Watkin on chemical porcelain was a record of many persistent attempts to convert the various clays found in different parts of the world into the finished materials satisfying many practical requirements. The latest and, according to Mr. Watkin, a completely successful attempt has been made in this country since the outbreak of war to produce in England a chemical procelain similar to that which was monopolised by Germany before the war.

Prof. Boswell instanced the fact that the war had greatly increased the output of glass and all kinds of metals and alloys, and he gave a record of work directed to the furnishing of British sand for the glass and metallurgical industries. Here the preliminary analytical work, which is of fundamental importance, forms a basis for all the far-reaching consequences which will follow for these industries in this country.

No finer example could be given than that of the modern gas industry illustrating the joint and successful co-operation of the chemist and the engineer, and the paper given by Mr. E. W. Smith, emphasising the merits of gas as an industrial fuel as against coal, etc., and that by Mr. C. M. Walter, exemplifying the use of gas in such operations as metal melting, annealing, hardening, etc., indicated the rapid progress made in recent years in the chemistry and the mechanics of this industry.

Perhaps no development of chemistry is fraught with greater consequences to mankind than the "Fixation of the Nitrogen of the Air." The success of rival processes designed to accomplish this result must in times of peace be determined mainly by practical considerations e.g. cost, etc. The rival methods at the present time are the direct method of oxidation of the nitrogen to nitric acid, and the production of ammonia by the combination of nitrogen and hydrogen. Various means of bringing about direct oxidation of nitrogen were shown by Mr. Kilburn Scott, including the Kilburn Scott furnace. Mr. Scott's furnace is intended to increase the efficiency of the process by bringing the whole of the air under the action of the electric spark.

Dr. Edward B. Maxted, in describing the synthesis of ammonia, showed how enormously important the very latest refinements of chemistry and physics are, in this very complicated process, for practical success. The nitrogen is actually separated from the air in the first case by passing through a column cooled by liquid nitrogen, the oxygen being liquefied and the nitrogen passing forward, whilst the residual mixture of oxygen and nitrogen undergoes fractionation in the lower part of the apparatus. The hydrogen is produced by the interaction of carbon monoxide from water-gas with steam, and many refinements and devices are needed to get pure hydrogen free from carbon monoxide at a workable cost.

The actual combination of the nitrogen and the hydrogen is brought about by catalysts consisting of various metals or combinations of metals. Here, again, a whole series of complications ensue from which the chemist has to make his choice, and iron containing traces of other bodies as promoters is preferred as catalyst. The reaction is carried out at pressures of 150–200 atmospheres and at temperatures approaching a red-heat, followed by cooling out of the combined product from the residual nitrogen and hydrogen.

Under such conditions the ammonia vapour is exceedingly corrosive, and presents a problem of considerable difficulty to the chemist and to the manufacturer; and, indeed, at every stage of this long process the problems to be solved by the joint ingenuity of the chemist and the engineer, and the manner in which they have been successfully solved, are astonishing. Finally, the ammonia is fixed as ammonium nitrate, or more usually as ammonium sulphate, as this can be more easily handled.

The sewage problem is of world-wide importance, and the stereotyped methods in vogue amongst engineers during the latter half of last century proved quite unequal to its proper solution. Since the chemist came to the rescue conditions have greatly improved, and great progress has been made towards a satisfactory solution. The activated sludge process described by Mr. Ardern illustrates very forcibly that a proper understanding of biological chemistry is essential to the correct solution of this problem, and that the engineer must accommodate his plant and his operations to the conditions established for him by the chemist and biologist.

The alleged value possessed by sewage sludge has long been a lure to engineers and others, and Mr. Ardern and his colleagues have demonstrated that activated sludge possesses considerable manurial properties. This question is a relative one, however, and the activities of the chemist in producing cheap fixed nitrogen will profoundly influence the engineering and commercial aspects of the sludge problem.

The overwhelming need in industry for research, and yet more research, was emphasised by almost every speaker, and in a notable speech dealing with this question Dr. C. A. Keane indicated that not in one way, but in many various ways, could science best be made to serve the needs of industry by means of research.

Twenty-five papers were read during the congress.

F. R. O'SHAUGHNESSY.

TECHNICAL EDUCATION IN SOUTH WALES.[1]

PRINCIPAL E. H. GRIFFITHS has published three lectures which important representatives of commerce and education in South Wales were invited to attend. The first two set out very clearly and at considerable length views in regard to the dependence of industry on science and with reference to science as an essential element in education; with these views the readers of NATURE are well acquainted and, for the most part, in cordial accord. In the third lecture the author deals with the existing provision for scientific and technological education in his district and with the lack of proper co-ordination.

In regard to the relations between the University of Wales and its constituent colleges, Principal Griffiths appeals for wider discretion for the colleges, either as parts of the existing federal University, or, if this be found impossible, as separate entities. He refers favourably to the inclusion of the Swansea Technical College in the reformed University, and there can be little doubt that this is desirable. Effective co-ordination of technological work between Cardiff and Swansea would be for the good of both; the former city should be willing to give up some branch of technology to Swansea, so that for advanced study in that branch Cardiff should send its students to Swansea, while the rest of the advanced work should be concentrated at Cardiff. Work up to the standard of the intermediate examinations for the B.Sc. degree might, of course, be taken in both towns.

In England, also, we have suffered from lack of co-ordination of this kind. Really advanced work needs very large expenditure on teachers, apparatus, and material; to duplicate it unnecessarily means a number of weak departments instead of one strong one. It would be well if the English provincial universities should come to some concordat such as is advocated for Cardiff and Swansea.

Allusion is made to the young and thriving School of Mines already attached to the Cardiff University College. The coalowners of the Principality have readily taxed themselves to provide this institution; it is fortunately free from excessive academic control, and can, therefore, render more readily useful service to the greatest industry of South Wales.

There are in the district flourishing technical institutions at Cardiff and Newport, and Principal Griffiths would like to see these take their proper places in a general scheme. One difficulty in carrying into effect all such proposals is that local education authorities are not always willing to take a broad view of what they can most effectively do. Many of them want to provide every kind of technical education within the walls of the institution which they control; but some of them are by no means equally ready to provide the very large funds needed to do this with real efficiency. So we find too often quantity preferred to quality; for only the wiser authorities seem to realise that ten highly trained technologists will be of far more value to an industry and to the State than a hundred persons with but a smattering of knowledge.

J. WERTHEIMER.

[1] "Industry, Science, and Education." By Principal E. H. Griffiths. Pp. 70. (Cardiff: Roberts and Co., 1917.) Price 1s.

THE TREATMENT OF WAR WOUNDS.[1]

II.

TREATMENT OF WOUND INFECTIONS.

IF you have now quite clearly apprehended the significant distinction between a live space and a dead space, you will with that have mastered the first great principle governing the treatment of all local bacterial infections. If you are dealing with infection in live spaces you can often mend matters by bringing (that is the rationale of hot fomentations) a larger blood supply—that means more lymph and more leucocytes—to the focus of infection; and again you can often mend matters by improving the quality of the lymph—that is the rationale of vaccine therapy; or again, you may apply both these procedures concurrently. But when you are dealing with an infected dead space you cannot in these ways mend matters. You might just as well take a test-tubeful of infected fluid and try by these means to influence it. Where you have infected dead spaces your remedial agent is the knife. You have to evacuate your dead space as I empty this test-tube.

Now that is the whole purpose and meaning of the surgery of the wound as carried out at the front. That can be summed up in two propositions. Every infected dead space must be cut down upon and evacuated. And, as a prophylactic measure, every space which would, if left to itself, become an infected dead space—that means every space occupied by an infected projectile or pieces of infected clothing or infected foreign bodies or devitalised infected tissues—must likewise be laid open and cleaned out. That exhausts the treatment of buried infections.

But it is only the beginning of the treatment of the wound. There is still the surface infection. The situation you have to face is just the same as that produced by emptying an infected tube; you have got rid of the infected contents, you have left the infection on the walls.

I now turn to the problem as to how best to deal with this infection. And here again inevitably we must establish distinctions. We must distinguish between the *naked tissue surface* made by the act of the projectile, or section with a knife, and the *granulating defensive surface*, which after a time clothes the naked tissues. In the former we have a non-vascularised surface, and in this a system of lymph spaces left without mechanical or biological protection other than that furnished by the emigration of leucocytes and (until that stanches) by the outflow of lymph. And the naked-tissue surface is not only ill-defended against microbic attack, it is also peculiarly liable to damage and to physiological deterioration of the kind which opens the door wider to such attack. Such a surface readily dries up; and drying means the closing down of the capillary circulation. Again, a naked-tissue surface, seeing that it is non-vascularised, readily takes cold, and by that both lymph outflow and emigration are arrested. And, lastly, a naked-tissue surface, if kept wet, will, so soon as the discharges become tryptic, readily undergo erosive digestion. Against all these forms of physiological degeneration special provision should always be made.

A granulating surface offers much greater protection against microbic infection, and is much less subject to damage. The tissues are covered in by many layers of protective cells, the lymph spaces are sealed over, and there has been laid down immediately below the surface in newly formed vessels a very abundant blood supply. All this is protection against massive microbic invasion from the surface, against the wound taking cold, and against erosive digestion. In short, there is with an infected granulating surface much less danger of a set-back than with an infected naked-tissue surface.

The Natural History of the Wound with a Naked-tissue Surface Left to Itself.

Let us consider the natural history of the untreated wound with an infected naked-tissue surface. I will take the case of an open shell wound left without treatment. According as it is wet or dry the evolution of this wound will be entirely different. Let us suppose that it is allowed to dry. Under the original dry dressing the blood and lymph flow from the surface will gradually stanch, and we shall then have a naked-tissue surface with a coating of coagulated blood and lymph. In this will be incorporated elements of moribund tissue, other elements of foreign matter, and always a certain number of microbes. Little by little the coating of coagulated blood and lymph upon the surface of the original wound, or of the surgeon's incisions, will dry up, and by that the capillary circulation will be closed down. And all the while the serophytic microbes will be proliferating. As a result of all this the superficial tissues will die and become gangrenous, and the originally clean naked-tissue surface will gradually be transformed into a dry, greenish-black, excessively fœtid, slough-covered surface pullulating with microbic growth.[2] Under the sloughs will then be formed infected dead spaces, and from these the infection—I am here thinking in particular of a gangrene infection—will invade the neighbouring live spaces, converting these in their turn into dead spaces until we have to cope with large areas of gangrene and a general intoxication.

That, of course, will happen only with very heavy infection or extreme physiological deterioration. With lighter infection or less adverse physiological conditions the invaded organism will have recourse to measures of defence. Gradually the superficial sloughs and gangrenous portions of the deeper tissues will be demarcated and then amputated from the living tissues—the amputating agent being, no doubt, the tryptic ferment in the dead spaces. And at the same time there will have been organised in the living tissues some little way back a defensive front built up on the same plan as a granulating surface.

Let me now tell you also what will happen if the infected surface is simply kept wet. Here, also, the microbes which have been incorporated in the clot would grow out. Then there would supervene leucocytic emigration, and upon that would follow a breaking down of the leucocytes with a setting free of trypsin; and after that any and every microbe would pullulate in the cavity of the wound and on the devitalised wound-surface. Finally, if treatment were still deferred there would be reproduced in an aggravated form (for there would in the open wound be a varied and more formidable infection) the evil train of events which is associated with infection in a buried dead space. When you reflect that an open wound cavity filled with tryptic pus is physiologically equivalent to an unopened abscess sac, you will see that erosive action will enlarge and deepen its cavity; that this will enable the microbic infection to burrow everywhere deeper into the walls; and that bacterial poisons will be absorbed.

All I have been saying in the last few minutes can be

[1] By Sir Almroth E. Wright, C.B., F.R.S. In its original form this lecture was delivered at the Royal Institution on March 9. It was supplemented by additional matter relating to antiseptics and the method of Carrel, and was printed in full in the *Lancet* of June 23. Parts of the lecture of purely technical interest have been omitted. Continued from p. 518.

[2] Let us note in connection with this that the albuminous substances of our tissues, when no longer bathed in lymph, are immediately degraded to the rank of unprotected native albumens.

compressed into this:—An infected naked-tissue surface becomes, if allowed to dry, *a desiccated slough-covered wound*; if simply kept wet, *a tryptic suppurating wound*. And the bacteriological events can also be expressed in a single sentence. A comparatively light infection, such as we have in the man whose wounds have been properly opened up and mechanically cleaned, is converted into a very heavy infection; and a purely surface infection into an infection invading the deeper tissues.

PROBLEM OF PREVENTING THE DEGENERATION OF THE WOUND WHEN TREATMENT IS INTERRUPTED DURING TRANSPORT.

Having realised what happens to the wound when untreated, we have to think out how to keep wounds —whether originally completely open or opened by a surgeon—from falling during protracted journeys from hospital to hospital into these desperately unwholesome conditions. We have also to consider how to restore, as rapidly as possible, wounds which have lapsed into distressing conditions either through lying out untreated on the field or through interruption of treatment during lengthy transport.

Suggestion that the wound could be sterilised at the outset, and could be kept sterile by leaving an antiseptic in the wound.—The first thought of every man would probably be that the wound should be most carefully disinfected at the outset. But what happens in burns shows that to start in open wounds with a sterile surface avails nothing. A burn is at the outset absolutely sterile, and quite notoriously—no doubt the germs begin to arrive before the burnt surface has well cooled off—it tends to become very rapidly intractably septic. We may take it that the emigrating leucocytes are held back in the superficial sloughs, disintegrate there, and corrupt the exuding lymph. And this cannot be prevented by any application of antiseptics. It is just the same with war wounds. These become heavily infected even when they are drenched at the outset with the strongest antiseptics, such as undiluted carbolic acid and concentrated solutions of iodine.

This is not the place for any lengthy discussion of the reasons for this failure of antiseptics. But the gist of the matter can be put quite shortly. The current belief in the therapeutic efficacy of antiseptics rests on experiments which are quite fallacious. They are fallacious in that the antiseptic in those experiments was applied in watery media—media which left that antiseptic unaffected. To have value—that is, to have application to conditions obtaining *in vivo*—the experiments should have been conducted in pus or serum—media which quench antiseptic action. Again, in the experiments of the past the antiseptics were intimately mixed with the bacterial suspensions; whereas, applied in the wound, the antiseptic comes only into external contact with the infected wall and the inflowing discharges. Employed thus we cannot expect it to diffuse into and exert a bactericidal effect either in the infected wall or in the discharges.

By reason of these considerations having been disregarded, the issue as to whether antiseptics applied in the wound with prophylactic intent can be of any use must be investigated *de novo*.

Experimental Investigation of the Efficacy of Antiseptics.

Let me now try to indicate to you what sort of experiments should be undertaken before nourishing in connection with a particular antiseptic the expectation that it is going to be efficacious for sterilising and afterwards suppressing microbic growth in wounds. I can illustrate my points best if you let me show you here four tubes.

In tube No. 1 I have a suspension of microbes in water. I now add an equal volume of the antiseptic I wish to test and shake up thoroughly. These are, as you see, conditions which give every possible advantage to the antiseptic. It is applied in a non-albuminous medium and is intimately mixed with the microbes. To find out whether the microbes have been killed I draw off a sample and dilute with very many times its volume of nutrient medium. I then incubate to see whether I get any bacterial growth.

In tube 2 I make the conditions more favourable to the survival of the microbes—infinitely more favourable than if I left behind an antiseptic in a wound. I have here a mixture of staphylococci, streptococci, and gas-gangrene bacilli suspended in serum, and I now, as in tube 1, add an equal bulk of the antiseptic and shake up, and I then, following the technique of Prof. Beattie, pour on a little hot vaseline which will afterwards congeal. This, forming an air-tight seal, will allow the gangrene bacillus, if it survives, to grow out. It will also announce the growth of this microbe, for it will confine any gas which may be evolved from the culture.

Tube 3 is, as you see (Fig. 10), a tube which has

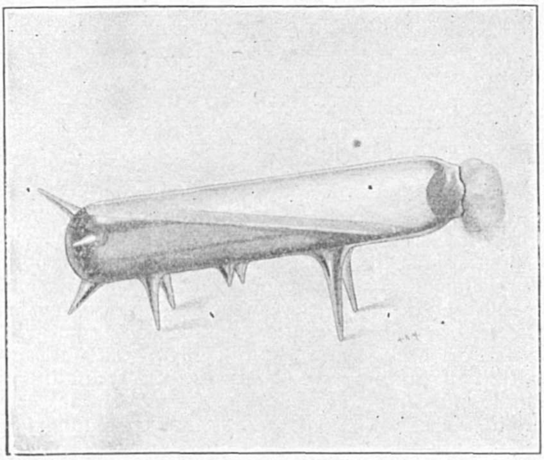


FIG. 10.—A test-tube standing on spike legs, representing a war wound with diverticula.

been drawn out into a number of hollow spikes to imitate the diverticula of the wound. My colleague, Dr. Alexander Fleming, its author and inventor, calls this form of tube the "artificial war wound." To imitate the conditions obtaining in the actual war wound we fill both the tube and its diverticula with an infected trypsinised serum. We now empty the tube, leaving behind of necessity in the diverticula a certain amount of the original infected fluid. We then fill with an antiseptic; and the future of the infection will now depend on the penetrating power of the antiseptic. If the antiseptic penetrates into the infected fluid sterilisation will be obtained; if it fails to penetrate, microbes will survive. To test our result we empty out the antiseptic, refill with trypsinised serum, and incubate.

After asking in tube 3 whether the antiseptic can completely sterilise a wound which has its recesses filled with an infected albuminous fluid, I go on in tube 4 to investigate the question as to how far the antiseptic can penetrate into the walls of the wound. Tube 4 is, as you see, a tube with hollow spikes. I have coated the inside with infected serum agar, and the spikes provide in their hollows a greater depth of infected lining and also securer purchase for the serum agar. The prepared tube is filled with antiseptic. And then we can, after an interval, pour out the antiseptic, fill in with nutrient broth or trypsinised serum, and then incubate. Any microbes which have been left alive in the lining will now grow out into colonies which can be inspected through the walls of the tube.

Let me show you a set of typical results obtained by the test-procedures just described, using Dakin's antiseptic, to-day perhaps the most popular of all antiseptics.

In tube 1 we have obtained, as you can see by these subcultures, complete sterilisation. And it was obtained after only momentary contact with the antiseptic. In tube 2, where a lightly infected serum was shaken up with an equal bulk of the antiseptic and then incubated, we have in our mixture of serum and antiseptic a very vigorous growth of microbes. You see the medium has become turbid, and there has been an evolution of gas which has pushed up the plug of congealed vaseline. In tube 3—and here the antiseptic stood for four hours in the tube—we have in the barrel a teeming multitude of microbes. And in tube 4, after four hours' contact with the antiseptic, only that very thin layer of the infected lining which coats the barrel has been sterilised, in the depth of every spike the bacterial colonies have come up quite thickly, and only in immediate contact with the antiseptic have the microbes been killed. And I here show you in a companion tube which has been incubated twenty-four hours longer that the microbes you have seen growing in the deeper layers very soon penetrate the sterilised superficial layer, and grow out in the culture medium in the barrel of the tube.

When we find an antiseptic giving results quite different from those here displayed it will then, for the first time, become a rational policy to use, and leave behind, an antiseptic in a wound with the view of safeguarding the patient during lengthy transport.

Suggestion that the bacterial infection in the wound can be kept down during transport by frequent re-applications of an antiseptic.—In the earlier period of the war the only method of re-applying an antiseptic was that of taking down the dressing, syringing the wound, and completely re-dressing. That was, especially in the case of deep wounds and compound fractures, a very lengthy and painful procedure, and one which was nearly impracticable in transport. For that complete re-dressing there has now been substituted by Carrel a procedure for washing and refreshing the surface of the wound through rubber tubes. According to Carrel, Dakin's antiseptic should be employed, and this should be applied every two hours. About the application of this in transport let me say this: that it would, I think, be impracticable to carry it out on a sufficiently large scale and sufficiently systematically; and Dakin's antiseptic applied in an unsystematic manner gives exactly the same results as simply keeping the wound wet.

Suggestion that the set-back in the wound during transport could be prevented by dressing with hypertonic salt solution.—The set-back in the wound with its resulting tragedies could, I think, be avoided by drawing out lymph in a continuous manner from the tissues, and holding up the emigration of leucocytes. The outflow of lymph would drive back and expel invading microbes. It would also prevent the conditions in the walls of the wound becoming unwholesome to leucocytes. The continuous outpouring of lymph would also effectively combat the corruption of the discharges in the cavity of the wound. And, lastly, it would prevent any drying up of the wound. The effect of holding up the emigration of leucocytes would be to prevent the corruption of the wound discharges. You will remember that leucocytes, breaking down, furnish the trypsin which corrupts the discharges.

We have in a hypertonic solution the therapeutic agent we require for these purposes. The proper way of using it is to apply to the wound three or four layers of lint thoroughly soaked in 5 per cent. salt solution; to impose upon these, as a reinforcement, three or four more layers of lint thoroughly soaked in saturated salt solution,[3] and then cover the whole with jaconet, or other impermeable material.

REMEDIAL TREATMENT.

I now pass from discussion of the method of preventing the set-back that occurs in transport to the discussion of its remedial treatment. The set-back will, as we have seen, have given us either a tryptic suppurating wound or a dry slough-covered wound. In each case the *first item in treatment* will be to get a clean surface. For that it will, in the case of the tryptic suppurating wound, suffice to wash away the tryptic pus. In the case of the desiccated slough-covered wound we must get rid of the sloughs. The rational way to do that will be by *cleansing digestion.* Such cleansing digestion can be obtained by treating the wound with hypertonic salt solution. This will, as we have already seen, break down leucocytes, setting free trypsin, and then the free trypsin will rapidly, and especially rapidly if we let the hypertonic salt undergo dilution, amputate the dead from the living tissues. Let us note that what we set out to do by the use of hypertonic salt solution is only to achieve more rapidly, and, as we shall see, with less risk of infection, what putrefaction and the destruction of leucocytes by microbes would, if we allowed things to run their course, spontaneously effect. The *second item* of treatment in each case will be to combat the infection which has found a lodgment in the walls of the wound cavity. To deal with this we require an outpouring lymph stream, obtained by hypertonic salt solution.

If the train of reasoning I have laid before you is correct, it will follow that hypertonic salt solution is the agent we require both for preventing the set-back due to interruption of treatment in transport, and also for remedial treatment.

EXPERIMENTS WHICH EXHIBIT THE PROPERTIES OF HYPERTONIC SALT SOLUTION.

You will very reasonably here expect me to produce experiments to show that a hypertonic salt solution has the virtues I ascribe to it. You will want to see for yourselves that it attracts water, draws out fluid from moist tissues, sets free trypsin from pus, and initiates digestion. There is room here[4] only for the two following experiments, which have reference to the digestive cleansing of the wound.

Experiment 1.—I have here, as you see, two test-tubes filled nearly to the top with egg-albumen. To this was added ½ per cent. of carbolic acid, and the albumen was then solidified by immersing the tubes in boiling water. That done, I took two cotton-wool plugs and steeped them in a pus to which I had added ½ per cent. of carbolic acid. I then inverted my tubes, the one into a beaker containing 5 per cent. salt, the other into a beaker containing physiological salt solution. (Fig. 11, A and B.) To these also I added ½ per cent. of carbolic acid. You will understand why I chose carbolic acid as my antiseptic when I tell you that it is one which does not destroy trypsin or impede digestion. You see in the drawings made

[3] The saturated solution diluted with six parts of water will give us our 5 per cent. salt.

[4] The experiments on the drawing action of strong salt solution were set out in the fuller report of the lecture published in the *Lancet* of June 23.

after the tube had been incubated for forty-eight hours, that in tube A, the tube which was immersed in hypertonic salt solution, the egg-albumen was extensively digested, while in tube B there was only a mere trace of digestion.

Experiment 2.—I here try to imitate the conditions of slough-covered wounds. I have in these beakers a

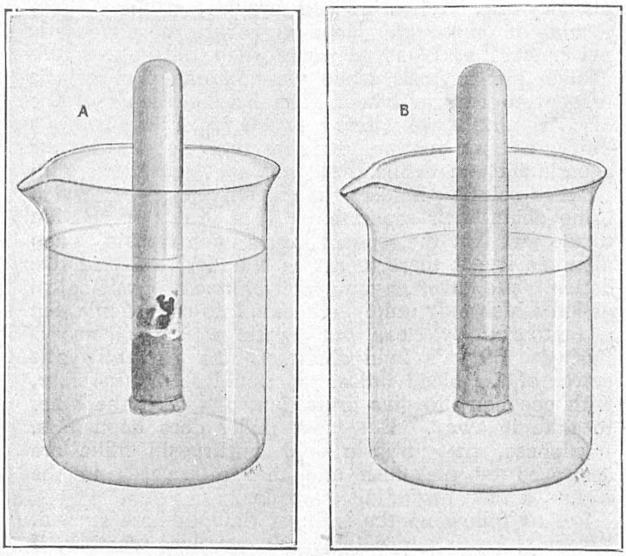


FIG. 11.—Test-tubes filled with coagulated egg-albumen; then plugged with cotton-wool impregnated with pus; and then inverted into beakers. Beaker A contains hypertonic, beaker B normal salt solution.

foundation of coagulated white of egg containing 0·5 per cent. of carbolic acid. On the top of this I have in each case a disc of lint, woolly side up, firmly fastened down by adding another layer of egg-albumen and coagulating this by heat. Upon the lint I have poured a non-tryptic pus, giving, of course, an equal amount to each beaker. In this way I have made what I think can pass as a fairly close representation

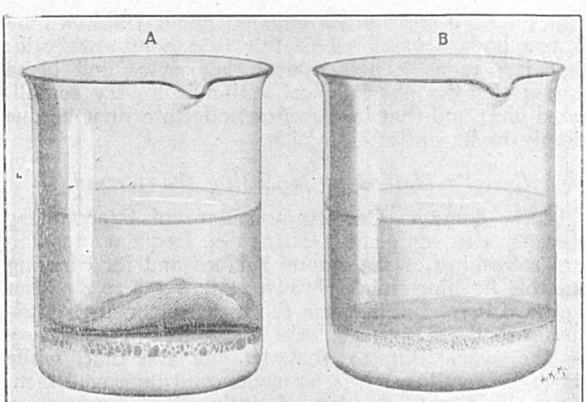


FIG. 12.—Beakers containing coagulated egg-albumen into which is embedded a layer of lint. Upon the lint was poured pus, and upon this in the case of beaker A hypertonic, and in the case of beaker B normal salt solution. In beaker A the artificial slough has separated off by tryptic digestion.

of a pus-impregnated slough firmly adherent to the floor of a wound. (Fig. 12, A and B.)

We now pour upon one of the artificial sloughs 5 per cent.; upon another 0·85 per cent. solution made up with $\frac{1}{2}$ per cent. of carbolic acid; and we may pour upon a third Dakin's solution. We now place them all in the incubator. You see here what has happened after twenty-four hours. In beaker A, where the artificial slough has been treated with hypertonic salt solution, the slough has loosened itself from its bed, and floats up as I pour in water. In beaker B, where I imposed only physiological salt solution, the slough is still firmly adherent. And the same holds of beaker C (not figured), where we have Dakin's solution.

TREATMENT OF THE WOUND IN THE CASE WHERE WE HAVE ONLY A SURFACE INFECTION.

When we have got back to a clean and only lightly infected surface we must think out our next step. It will help if we first review what we have learned and get things into proper perspective.

We have learned that there are in wound infections two supreme dangers. *First,* there is the danger associated with the buried infection. We have appreciated that the effective and only remedy for this is the immediate opening up of the infected dead spaces. That, you will remember, is a question of converting a buried infection into a surface infection. The *second* very serious danger is that intensification of the surface infection which follows upon a lengthy interruption of treatment during transport. This, regarded from the point of view of loss of life and limb, ranks next in order of importance after delay in dealing with the buried infection. When the set-back due to transport has been prevented or remedied, we have confronting us the problem which, if treatment had been uninterrupted, would have presented itself earlier—the problem as to how to treat a slight infection of a naked-tissue surface.

One procedure is to leave the wound to heal up from the bottom, limiting oneself to such re-dressing as would prevent erosive digestion. By this programme the patient would, when his wound is a large one, be condemned to very many months of disability and also of bacterial intoxication. For the fact has got to be faced that it is all but impossible to maintain satisfactory conditions in a large wound for months on end.

The alternative programme is for the surgeon to close the wound with the minimum delay. If the anatomical conditions permit, and the bacteriological examination shows the wound surface to be practically uninfected, or if the wound is only a very few hours old and the implanted microbes cannot yet have grown out, the wound can, after removal of all dead and foreign matter, be immediately closed—the surgeon, of course, standing by to reopen the wound if symptoms of buried infection develop. If, on the other hand, bacteriological examination shows that the wound surface is appreciably infected, or the history of the case makes this practically certain, we should, by closing the wound, be violating all the principles of surgery. We should be converting a surface infection into a buried infection. The proper step to take with a wound which is appreciably infected is to reduce the microbic infection to the point at which it is negligible and then re-suture.

Methods of Dealing with a Microbic Infection which Stands in the Way of Secondary Suture.

The microbic infection may be dealt with by any one of the following procedures.

In the *first place* we can employ the physiological procedure. If we elect to do this, we must think out clearly the requirements. For example, it will be inappropriate when dealing with a purely superficial streptococcic and staphylococcic infection to continue the application of hypertonic salt solution. The effect of that would be, on one hand, to hold off phagocytes from the microbes (for strong salt arrests emigration); and, on the other, to provide the staphylococcus and streptococcus with lymph, a fluid in which they can grow and disseminate themselves over the whole face of the wound. What we want is an application which calls out leucocytes, which will restrain, or at any rate will not activate, the lymph flow. Physiological salt solution, and zinc sulphate in ¼ per cent. solution, and no doubt many other heavy metal salts in dilute solution, are the sort of agents we require. But what is, above all, essential to success in physiological treatment of a surface infection is assiduity in removing any leucocytes which may break down upon the face of the wound. That is a question of maintaining intact the antitryptic power of the lymph on the wound surface.

A *second method* of procedure—I may call it the *unreasoning antiseptic procedure*—is to employ an antiseptic, without laying stress upon the assiduous cleansing of the wound surface and the maintenance of good physiological conditions; without inquiring whether the antiseptic can, when brought into external contact with pus or an infected tissue, penetrate into it; and without asking whether the antiseptic hinders phagocytosis, or destroys the antitryptic power of the blood fluids, or permits or interferes with tryptic action.

This unreasoning antiseptic procedure is constantly employed. It has led to failure upon failure, and it would be a matter for wonder if it did succeed.

The *third* and last method of procedure I may call the *combined antiseptic and physiological procedure*. If we want to find a method of this sort we shall not find it by inquiring for it under this name. What we have to seek is a method which proclaims itself an antiseptic method and in this guise combats effectively, but perhaps not with full comprehension, corruptive changes in the wound.

The method of Carrel is, as I think, such a method. I would propose to show that it is a combined antiseptic and physiological method; then to survey the results obtained; and, finally, to consider how far the results should be credited to the antiseptic, and how far to the physiological, element in the treatment.

We have in Carrel's treatment two factors: (*a*) Dakin's antiseptic, or, as I should prefer to call it, Dakin's therapeutic agent; and (*b*) Carrel's procedure for washing and refreshing the wound surface in the intervals between the complete dressings. Now each of these factors acts not only by killing or removing microbes, but also by making the conditions in the wound unfavourable for microbial growth. Let me, taking first Dakin's fluid and then Carrel's washing procedure, try to make for you an inventory of their directly anti-bacterial, and their physiological or indirectly anti-bacterial, effects.

Dakin's Fluid.

Dakin's fluid is, as I have shown you,[5] a very ineffective antiseptic when it is brought into application upon microbes suspended in serum. It is also, as I have likewise shown you, an antiseptic which has as good as no power of penetrating into albuminous fluids. It is also an extremely volatile antiseptic. When exposed in a shallow dish at blood temperature I have found it to lose four-fifths of its potency in half an hour, and it will, as I have already had occasion to point out, if not already quenched by contact with serum, very quickly disappear from the wound.

Turning from the effect exerted upon microbes to the effect exerted upon the wound surface, let me recall to those of you who have seen it that when a naked-tissue surface is treated with Dakin's fluid (or, for the matter of that, with 5 per cent. salt solution) it is speedily converted into a bright coral-red granulating surface. That means it is converted into a defensive surface excellently well provided with new-formed blood-vessels from which active leucocytes and fully potent lymph will emerge. That is a physiological action to the good. But there are also other effects exerted. Leucocytes are affected by Dakin's fluid. Experiments show that it is destructive to phagocytosis. When we add one part of the reagent to nine of *excoagular blood* we reduce the phagocytic power of that blood by more than one-half. We abolish phagocytosis when we add one part of the reagent to four of blood. The fluid elements of the discharge also are altered in character by Dakin's fluid. Let me remind you here that we saw in our experiments on artificial sloughs that treatment with Dakin's solution hinders the digestive processes which bring about their separation. This stands in relation to the fact that the reagent exerts upon trypsin, when albumen is not there to act as a buffer, a destructive action. We have, as you perceive, here a physiological action which may quite well come into operation when a comparatively clean but tryptic wound surface is flushed. Dakin's fluid abolishes also the antitryptic power of the blood fluids. It would seem, therefore, with one hand to give protection, and with the other to take it away. But what really does happen is, I suppose, that trypsin and antitrypsin alike are destroyed by the flush and that afterwards in the wound a new beginning is made.

Let us follow up the train of thought here started. We may, I think, profitably ask ourselves whether, if put to our election between maintaining antiseptic action continuously at the expense of physiological action, and alternating antiseptic with physiological action, we should not do well to elect for the latter policy. And we may muse whether it was not specially felicitous to have employed, as Carrel has done, an antiseptic which is very readily quenched and also very volatile and to have applied it discontinuously. Had that antiseptic been employed by a method of continuous irrigation, phagocytosis on the face of the wound would have been excluded, and we might have had in the cavity of the wound a lymph the antitryptic power of which had been destroyed.

But I have already said enough about Dakin's fluid if you have appreciated that it is a poor antiseptic; that it acts as a poison upon leucocytes and blood fluids; that its physiological action is a very complicated one; and that its beneficial effects cannot be due simply to its antiseptic action.

Carrel's Method of Irrigating the Wound.

I now come to Carrel's procedure of intercalating between the complete dressings a frequent flushing and refreshing of the wound surface and for carrying out this flushing unlaboriously. Allow me to say that we have here, I think, far the most important contribution made to surgical technique since the beginning of the war. But to that let me add that, while Carrel's procedure gives us a new and improved technique for the application of antiseptics, much more does it give us a new and improved technique for physiological treatment. In all physiological treatment the assiduous removal of corrupted and corruptible discharges is the primary desideratum.

We now turn to the results of the treatment of infected wound surfaces by Carrel's method, and we may take them from Carrel's book. But it will be well, in order to keep to the kind of wound infection here under discussion, to exclude from consideration wounds complicated with fractures—for in those effective washing is difficult. And we may further, looking to the classification of wounds of soft parts in

[5] *Vide supra*, Experiments on Antiseptics.

Carrel's book, exclude from consideration his class of phlegmonous and gangrenous wounds and his class of suppurating wounds. These would correspond to wounds which have, through postponement of treatment or its interruption by transport, suffered a setback, converting an originally light surface infection into a heavy infection with invasion of the deeper tissues. There would then fall within our purview only his class of fresh wounds of soft parts taken in hand when five to twenty-four hours old. And we learn from the data he gives with respect to these that, where there are sloughs, fifteen to twenty days, and, where there are none, five to twelve days, are required to prepare the wound for secondary suture. That gives us a measure of what can be done by what I have, I hope not unjustifiably, called Carrel's "combined antiseptic and physiological treatment."

Let us consider what Carrel's results tell us. They tell us in the first place that, whatever else it is, Carrel's treatment is not in any sense a *therapia magna sterilisans*. Regarded as an antiseptic method, it is a method of "*fractional sterilisation*" requiring for the case we are considering—the simplest case of all—at the rate of twelve douches a day a series of 60 to 144 antiseptic douches. And if I am right in regarding Carrel's treatment as a combined antiseptic and physiological treatment, we have, superadded to the antiseptic, a series of 60 to 144 physiological attacks upon the microbes—each such attack starting from an atryptic condition.

The consideration of these figures leads directly to what I have to say in conclusion. While Carrel's work constitutes a very notable practical achievement, regarded as science it comes short in the respect that adequate control experiments are lacking. I do not mean that it has not been demonstrated that Carrel's treatment accomplishes what was impossible by the old system of syringing with antiseptics and leaving the wound afterwards to fill with pus. The inefficacy of that older treatment was attested by tens and hundreds of thousands of control experiments. What I mean is that we have not in Carrel's work any control experiments with more potent and penetrating antiseptics to negative the idea that with these one could with fewer than 60 to 144 consecutive douches convert a light surface infection into a negligible one. And again, we have not from Carrel any control experiments with a well-thought-out physiological treatment to negative the idea that one could achieve a similar sterilisation by 60 to 144 successive physiological attacks upon the microbes, starting each time from an atryptic condition.

If we would abide in the spirit of science, every unwarranted assumption must go. We must not assume that when we have successfully combated a surface infection by a series of 60 to 144 therapeutic operations we have reached finality. And much less must we, from the fact that a treatment successfully combats surface infections, infer that it is also an effective treatment for infections which penetrate into the deeper tissues. It ought to come home to us instead that it is impossible that for quite different categories of wounds, *i.e.* for quite diverse conditions, there should be any one routine treatment.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A PAMPHLET has been received from University College, London, giving full particulars of the University centre for preliminary and intermediate medical studies arranged in connection with the faculty of medical sciences of the college. The college faculty of medical sciences comprises the departments of physics, chemistry, botany, and zoology (the preliminary medical sciences), also the departments of anatomy, physiology, and pharmacology (the intermediate medical sciences), and the departments of hygiene and public health and of pathological chemistry (post-graduate study). Each of the departments is also equipped for more advanced work and provides facilities for research. Numerous scholarships and exhibitions are available for intending medical students, detailed regulations concerning which can be obtained on application to the secretary, Dr. W. W. Seton, at the college.

THE calendar for the session 1917–18 of the Royal College of Science for Ireland has now been published. The college provides a complete course of instruction in those branches of science which are connected with agriculture, engineering, and manufactures, and it trains teachers of science for technical and secondary schools. By the prosecution of researches in pure and applied science the college has been able to render aid to the agricultural and industrial development of Ireland. The regular courses of study extend over four years, and lead to the associateship of the college. The fellowship of the college may be awarded to any associate of at least three years' standing who submits a thesis, which shall meet with the approval of the dean and council, embodying the results of his own original scientific research, or who has submitted satisfactory evidence that he has contributed in a marked degree to the advancement of science. A limited number of research studentships may be awarded each session to qualified persons who desire to prosecute approved lines of research. The college is administered by the Department of Agriculture and Technical Instruction for Ireland.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 13.—M. Paul Appell in the chair.—G. **Humbert**: The reduction (mod 2) of quadratic binary forms.—C. **Richet** and H. **Cardot**: A new method of determining the reducing substances in urine. The diluted urine is allowed to act upon an acidified solution of potassium permanganate under conditions such that the urea is not oxidised. A manganese coefficient for normal urine is established, and this is shown to be independent of the total urea excreted.—E. **Cahen**: The series of best absolute approximation for a number.—L. **Picart**: The total eclipse of the moon of July 4, 1917. Observations made at the Bordeaux-Floirac Observatory showed that during the whole period of total eclipse the north edge of the moon was more luminous than the south edge; the western edge was more luminous up to the middle of the eclipse.—G. **Sizes**: The German gamma termed "harmonic," or "exact," or improperly modern, from the point of view of musical acoustics.—P. **Portier**: The physiological *rôle* of symbiotic micro-organisms.—MM. **Abelous** and **Aloy**: The biochemical phenomena of oxido-reduction. Repeating the experiments of Bach on the ferment in milk, it was found that a large number of substances besides aldehydes may act as co-ferments, such as amines, terpenes, and manganese salts. Details are given of the simultaneous reduction of sodium chlorate and oxidation of salicylic aldehyde. —Mme. C. **Cardot** and H. **Cardot**: The analogy between the lactic ferments and streptococci from the point of view of the action of disinfectants. The growths of the lactic bacillus and streptococcus under the action of increasing amounts of two antiseptics, sodium fluoride and phenol, were compared. The curves expressing the results of the experiments show close agreement, and the authors conclude that laws established for a non-pathogenic bacillus, such as the lactic ferment, may be applied to pathogenic organisms.

August 20.—M. J. Boussinesq in the chair.—Y. **Delage**: First results of the study of deep currents by means of the bathyrheometer.—J. **Deprat**: The inflexions of the tectonic directions in the north of Annam and their relations.—Mlle. M. **Bensaude**: Sexuality in the Basidiomycetes.—A. **Lécaillon**: Biology of the caterpillars and moths of *Bombyx mori* having a parthenogenetic origin.

PETROGRAD.

Academy of Sciences (Physico-mathematical Section), April 12.—E. S. **Fedorov**: Application of the principles of the new geometry to crystallo-optics.—V. Ja. **Roškovskij**: Contributions to the study of the family Lymnæidæ.—V. V. **Zalenskij**: The development of the embryo of *Salpa bicaudata*.—V. K. **Soldatov**: Description of a new species of Krusensterniella, Schmidt.—A. **Šestakov**: The new species of the genus Cerceris, Latr., in the Zoological Museum of the Academy of Sciences.—V. L. **Bianchi**: (1) Notes on the Russian Chiroptera. (2) Notes on the avifauna of North Tobolsk. (3) The birds of Francis Joseph Land collected by Lieut. Sedov's expedition.—A. F. **Samojlov**: Positive oscillation of the current of repose of the auricle of the turtle during excitement of the pneumogastric nerve.—I. S. **Plotnikov**: The softening and bending of carbon at high temperatures.—N. S. **Kurnakov**, K. F. **Běloglazov**, and M. K. **Šmatko**: Deposits of potassium chloride in the Solikamsk salt formation.

April 27.—M. D. **Zalěsskij**: *Noeggerothiopsis aequalis*, Goepp. sp., on the foliage of *Mesopitys Tchihatcheffi* (Goepp.), Zalěsskij.—A. S. **Vasiljev**: Correction of the length of the Moloskovitzi and Pulkovo bases measured in 1888.—V. S. **Žardeckij**: Researches on the spectrum of the variable η Aquilæ.—A. S. **Vasiljev**: The monthly period in the variations of latitude.—M. M. **Kamenskij**: Researches on the motion of Wolf's comet.—N. N. **Donič**: Observations of the solar eclipse of April 16–17, 1912.—V. Č. **Dorogostajskij**: The birds of the Government of Irkutsk.—V. F. **Ošanin**: (1) The genera of the family Strachiaria, Put. (Heteroptera, Pentatomidæ). (2) Two new species of Pentatomidæ from southern Persia.—S. F. **Žemčužnij** and V. K. **Petraševič**: Electric conductivity and hardness of manganese-copper alloys.—A. A. **Borisiak**: Description of the skeleton of a small rhinoceros, *Epiaceretherium turgaicum*.—O. A. **Walther**: The dialysis of diastases.—V. N. **Ipatjev** and A. **Andriuščenko**: The absorption of carbonic acid by saline solutions under high pressure.

Historico-philological Section, April 19.—K. A. **Inostrancev**: The Iran-Vedža river in Parsee tradition.

BOOKS RECEIVED.

Report of the Royal Ontario Nickel Commission, with Appendix. Pp. xlviii+219+62. (Toronto: A. T. Wilgress.)

La Force et le Droit, le Prétendu Droit Biologique. By Prof. R. Anthony. Pp. 194. (Paris: F. Alcan.) 2.50 francs.

Food Poisoning. By E. O. Jordan. Pp. viii+115. (Chicago: University of Chicago Press; London: Cambridge University Press.) 1 dollar, or 4*s*. net.

Finite Collineation Groups, with an Introduction to the Theory of Groups of Operators and Substitution Groups. By Prof. H. F. Blichfeldt. Pp. xi+193. (Chicago: University of Chicago Press; London: Cambridge University Press.) 1.50 dollars, or 6*s*. net.

Library of Congress. Report of the Librarian of Congress and Report of the Superintendent of the Library Building and Grounds for the Fiscal Year ending June 30, 1916. Pp. 236. (Washington: Government Printing Office.)

Smithsonian Contributions to Knowledge. Vol. xxxv., No. 3. A Contribution to the Comparative Histology of the Femur. By Prof. J. S. Foote. Pp. ix+242+plates 35. (Washington: Smithsonian Institution.)

A Course in Mathematical Analysis. Differential Equations, being part ii. of vol. ii. By Prof. E. Goursat. Translated by Prof. E. R. Hedrick and O. Dunkel. Pp. viii+300. (Chicago and London: Ginn and Co.) 11*s*. 6*d*. net.

The Munition Workers' Handbook. A Guide for Persons taking up Munition Work. With special chapters on Shell Turning and Gear Cutting. By E. Pull. Second edition. Pp. 158. (London: Crosby Lockwood and Son.) 2*s*. 6*d*. net.

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MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.