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INJURY BY LIGHTNING.

A VERY important paper on this subject, by Dr. Hellmann, was issued last year by the Prussian Statistical Office. The general conclusions have been translated and published in the "Monthly Weather Review" of the United States Signal Service, and we think them of sufficient importance to reprint them *in extenso*. When will our Government order a similar investigation to be made respecting injury in the British Isles?

The observations from which the following conclusions are drawn have been made in different parts of the German Empire, for the past ten years.

1. Statistics show that in Schleswig-Holstein, Baden, and Hesse, in thickly settled districts, a constant increase of damage from lightning does not appear to be proven any more than a decrease.

2. The yearly as well as the daily periodicity of lightning flashes corresponds very closely with the storm frequency. One interesting fact, previously noted, is that on the west coast of Schleswig-Holstein the greatest number of lightning flashes occur in the first hours after midnight.

3. In Schleswig-Holstein, in the ten years from 1874 to 1883, of all the buildings struck by lightning, of those with "hard" roofing, 9 per cent. caught fire, 91 per cent. did not; with "soft" roofing, 68 per cent. caught fire, 32 per cent, did not; so that buildings with "soft" roofing when struck by lightning catch fire from seven to eight times as often as those with "hard" roofing. Besides this consideration of the nature of the roof, the nature of the building is of importance. Averaging for a year of a million instances:

Ordinary buildings (with "hard" roofing, 163, with "soft" roofing 386) 290 are struck; churches, 6,277 are struck; wind-mills, 8,524 are struck; manufactories, chimneys, &c., 306 are struck.

In Schleswig-Holstein, the risk from lightning to churches and bell-towers is thirty-nine times, and in the case of wind-mills fifty-two times, greater than in the case of ordinary buildings with hard roofs.

4. In the case of Schleswig-Holstein the marsh lands from Husum to Steinberg are often struck while the country round the fords of the east coast is entirely protected. The coefficient representing the number of buildings struck of a million is generally from four hundred to five hundred and forty; but here falls to one hundred and sixty or one hundred and seventy, *i.e.* about one-third. The great danger in the case of flat and moist lands comes

from the fact that the farm premises are the most prominent features of the landscape, and the ground, besides, is quite moist.

5. The risk of danger from lightning decreases with increase of number of houses contained in any given district. In Prussia the risk in the country is five times greater than in the city districts. In Berlin the number of fires caused by lightning averages only 0·2 to 0·3 of one per cent. For an ordinary dwelling house, which stands among others, not particularly high, the erection of a lightning-rod is not needed.

6. In the Grand Duchy of Baden differences in the distribution of lightning strokes are found. In Heidleberg of a million, twenty-four buildings are struck, while in Waldshuter the rate is two hundred and sixty-five.

7. In the northern half of Baden and the neighbouring half of Hesse the number of buildings struck between 1868 and 1883 shows a decrease.

8. In Hesse the parts protected best are regions along the Rhine, where the encircling hills and mountain sides are interposed to protect them. But the danger is increased where, as in the case of Rhine Hesse, the country above is wooded.

9. The causes of variations in the number of buildings struck are to be sought in local causes and not in extra-territorial happenings. The supposed relation between frequency of lightning strokes and sun spots appears to have no foundation.

10. Averaging for fifteen years, of a million of people, the number killed by lightning is, in Prussia, 4.4 ; Baden, 3.8 ; France, 3.1, and Sweden, 3.0.

11. The geological features of the ground, particularly the water capacity, have a marked influence upon the number of lightning strokes. If we call a chalk-bed, 1 ; then we have for marl, 2 ; for clay, 7 ; for sand, 9 ; and for loam, 22. These conditions have much to do with the frequency of lightning strokes in the flat lands of northern Germany, as compared with southern Germany and Austria.

12. Differences in space and distribution of lightning strokes are due to four causes ; two of a physical and two of a social nature. The first, the unequal frequency of storms, and the difference in the geological character of the earth ; the latter, the changing and the improved construction of buildings.

13. Of all trees, the oak was most frequently and the beech least frequently struck. If we let 1 equal the beech, then pines are 15, oaks 54, and other trees 40.

14. Most frequently the trees struck were standing in the clear, or on the edge of forests, and averaging from sixteen to twenty metres high.

15. The trunk is struck about three times as often as boughs, and generally the stroke seems to travel toward the ground. Only in three of one hundred cases did it jump to other trees.

ROYAL METEOROLOGICAL SOCIETY.

The usual Monthly Meeting of this Society was held on Wednesday evening, March 16th, at the Institution of Civil Engineers, 25, Great George Street, Mr. W. Ellis, F.R.A.S., President, in the chair.

Mr. G. Eyres, Mr. J. T. Hotblack, and Capt. C. H. M. Kensington, R.E., were balloted for and elected Fellows of the Society.

The following papers were read :—

(1.) "Notes on taking Meteorological Observations on Board Ship," by Capt. D. W. Barker, F.R.Met.Soc. The author makes various suggestions as to the placing of meteorological instruments on board ship with the view of securing uniformity.

(2.) "Marine Temperature Observations," by Dr. H. R. Mill, F.R.S.E. After briefly sketching the principal historical methods of observing temperature beneath the surface of the water, Dr. Mill discussed in some detail the relative merits and defects of the two instruments now in common use for this purpose. The self-registering maximum and minimum thermometer on Sixe's principle, even with the addition of an outer bulb to protect it from pressure, has certain inherent defects. It merely shows the highest and lowest temperatures passed through, the indices are liable to be shaken from their proper position, and it requires long immersion in order to attain the temperature of its surroundings. Mr. J. Y. Buchanan has shown how by the use of mercury and water piezometers the actual temperature at a given point may be obtained, no matter how the temperature between that point and the surface may vary. Such instruments have not been much used, and now a modification of the mercurial outflow thermometer, patented by Messrs. Negretti and Zambra as the "Standard deep-sea thermometer," is largely used. When fitted in a frame which admits of the thermometer registering at a precisely known depth, admirable results are obtained by it. The manner of using these thermometers in the Scottish frame, and of conducting temperature trips in comparatively shallow water were described; and the best ways of recording the observations and elaborating the results were alluded to; the work of the Scottish Marine Station on the Clyde Sea-area being taken as an illustration. The importance of marine temperature observations as bearing on sub-marine geography, on navigation, on the distribution of animal life, and consequently on fisheries was alluded to. The paper was illustrated by diagrams and by the exhibition of the apparatus which was described.

After the reading of these papers the Meeting was adjourned in order to afford the Fellows an opportunity of inspecting the Exhibition of Marine Meteorological Instruments and Apparatus which had been organised under the auspices of the Society.

EXHIBITION OF MARINE METEOROLOGICAL INSTRUMENTS.

An interesting and instructive Exhibition of Marine Meteorological Instruments, organised by the Royal Meteorological Society, was opened on Tuesday, March 15th, in the Library of the Institution of Civil Engineers, 25, Great George Street. Specimens of almost every kind of instrument used for taking meteorological

observations at sea were included in the Exhibition; sets of instruments as supplied to the British, French, Dutch and other Navies being shewn. There were numerous forms of Deep-sea Thermometers, including Johnson's registered metallic, the records of which are obtained by the varying expansion of brass and steel bars acting upon indices; Miller-Casella maximum and minimum; and Negretti and Zambra's reversing thermometer. Special interest attaches to the instruments used on board the *Challenger*, many of which were constructed by Mr. Buchanan during the voyage of that vessel. The instruments and apparatus used at the Scottish Marine Station, Granton, near Edinburgh, and at the Lochbine Marine Institute, Isle of Mull, were also shewn. In addition to the above there were various forms of Anemometers, Rain-gauges, Logs, Current Meters, Clinometers, &c., for use on board ship.

The Exhibition also included a number of Diagrams, Photographs, &c., shewing the meteorological conditions prevailing over the various oceans of the globe. The most interesting charts were the specimens of the Daily Synchronous Weather Charts of the North Atlantic, exhibited by the Meteorological Council; examples are given shewing the meteorological conditions (1) in summer, (2) in winter, and (3) in early spring, illustrating the persistence of the European anticyclone producing cold dry winds over England.

A number of new instruments brought out during the past twelve months were also shewn.

The Exhibition remained open till Friday evening.

THE SNOW OF MARCH 15TH.

To the Editor of the Meteorological Magazine.

SIR,—As the chief severity of the recent snowstorm appears to have fallen upon this part of the country, the following particulars may be of interest:—

Snow commenced before daybreak on March 15th, and continued throughout the day. At 7 a.m. the depth, as seen on the coping of a wall, was judged to be about 4 inches. At 9 a.m. a measurement on a gravel walk gave a depth of 10 inches and by 5 p.m. this had increased to 15 inches. The snow lay nearly level, and was of very light texture. The downfall did not entirely cease until near midnight, and next morning it was found that 2 inches of fresh snow had fallen since 5 p.m., on a board then exposed. The old snow, however, had become so far compressed by its own weight, that the total depth, including the fresh snow, was reduced to 14 inches.

To ascertain the depth of water, three independent methods were employed.

1. The snow collected in the rain-gauge was removed, and melted on the morning of the 15th, and again on the morning of the 16th.

To effect the removal as accurately as possible, the snow about the gauge was trodden down and scraped away until a cylinder of snow remained above the funnel equal in diameter to the receiving surface.

2. At 5 p.m. on the 15th, the cylinder of an old gauge was inverted over 15 inches of snow, the whole of which was taken up with the cylinder. To the melted product was added the product of the 2 inches of snow which fell after 5 p.m., collected separately.

3. At 5 p.m. on the 15th, snow was removed from a gravel walk in such manner as to leave a block of snow 12 inches square, and 15 inches deep. This block being removed and melted, yielded exactly five pints of water, and this was reduced by calculation to vertical depth over an area of 12 inches square. The product of the 2 inches that fell after 5 p.m., was added as in the second experiment.

The mean result obtained by these three methods was 1·25 in. as the total depth of snow measured as water, and it is satisfactory, in view of the necessary roughness of the processes, that the largest deviation of any one result from the mean did not exceed four hundredths of an inch.

As regards the equivalence of snow and water on this occasion, I adopt the three following conclusions :—

1. From the mean of experiments 2 and 3, it results that 15 inches of fresh-fallen light dry snow, yielded 1·19 in. of water—proportion 12·6 to 1.

2. Fourteen inches of the same snow with an addition, measured 10 hours after it had ceased falling, yielded 1·25 in. of water—proportion 11·2 to 1.

3. The last 2 inches of the snow, collected and measured separately, yielded 0·09 in. of water—proportion 22 to 1. So great is the difference due to superincumbent pressure.

I know of no previous record of so deep a snow in this locality. The nearest approach was a depth of 12 inches on the 19th of March, 1867, just 20 years ago. In the great snow of January, 1881, the average depth here was 9 inches ; in that of December last, it was 4½ inches. The comparative absence of wind with the recent snow, and the lightness and dryness of the snow itself, reduced very much the inconvenience and damage sustained. The trees and shrubs were loaded to a degree very seldom seen, but even these suffered less injury than on some former occasions. The appearance of the trees was strikingly beautiful. The most troublesome consequences arose from the great weight of the snow on the roofs of houses, shutes in particular being borne down by the pressure.

GEORGE F. BURDER, M.D.

Clifton, March 25th, 1887.

From March 12th to 21st snow showers were frequent over the British Isles, but were generally slight with the exception of the fall of the 15th. On that day snow fell over almost the whole of the southern part of England and Wales, the fall being greatest over Monmouthshire and the mouth of the Severn, so that Dr. Burder had an opportunity of accurately recording almost, if not quite, its

greatest depth. In a northerly direction the quantity decreased rapidly, but over a large district extending southwards and eastwards was unusually great, though it varied considerably and apparently irregularly. The depth was carefully measured at the following stations :—

Clifton, Bristol	15 inches	Ross, Herefordshire	5 inches
Llanfrechfa Grange, Mon.	14 ,,	Camden Square, London..	5 ,,
Tiverton	12 ,,	Orleton, Tenbury	2 ,,
Pinner Hill, Middlesex ...	9 ,,		

Although nearly all the snow fell in 24 hours, it was measured partly at 9 a.m. on 15th and partly at 9 a.m. on 16th ; it has, therefore, been necessary, in the following table of the yield of water, to include the record for both days :—

Div.	Station.	Snowfall, March 14th & 15th. in.	Div.	Station.	Snowfall, March 14th & 15th. in.
V.	Warminster	1·74	V.	Weymouth, Langton Herring	·91
XI.	Llanfrechfa Grange	1·41	XI.	Llechryd, Castle Malgwyn..	·70
VI.	Clifton, South Parade	1·25	III.	Oxford, Magdalen College..	·61
V.	Beaminster Vicarage	1·23	VI.	Cirencester, Further Barton	·60
,,	Temple Combe, Stowell Rec.	1·23	II.	Strathfield Turgiss.....	·57
XI.	Cardiff, Ely	1·20	V.	Salisbury, Alderbury.....	·53
I.	Pinner Hill	1·10	I.	Finchley	·52
V.	Wells, Westbury	1·02	XI.	Llandovery	·52
,,	Tiverton	1·00	VI.	Stroud, Upfield	·51

EXTREMES OF RAINFALL.

To the Editor of the Meteorological Magazine.

SIR,—The rainfall on the Radnor Forest for the last six months (October 1st, 1886, to March 31st, 1887) presents some very exceptional features, and I think that you may like to have a note of them.

There fell, from October 1st to March 31st last, in the six months at my station, 21·58 inches of rain, which may be taken probably, as nearly as possible, as the average. But there are two markedly distinct periods to it, from October 1st to January 19th inclusive (or three-and-a-half months), when 18·58 inches fell ; while from January 20th to March 31st (or two-and-a-half months) exactly 3 inches fell ; and from January 20th to March 20th inclusive (or two full months), exactly 1·50 inches fell, there having been only five days in the two months on which more than a tenth of an inch of rain fell, and only nineteen days on which one hundredth or more of rain fell. I may add that the dry period continues.

Yours very truly,

G. F. PEARSON.

Downton, Kington, Herefordshire,
7th April, 1887.

DAY AND NIGHT BREEZES.

To the Editor of the Meteorological Magazine.

SIR,—In calling attention to a mistake in my letter on this subject at page 6, where, line 28, "5.15 p.m." should be "5.15 a.m.," I may also state that, since writing that letter, I have received a paper by Mr. F. Chambers, read before the Royal Society, 19th June, 1873, and appearing in the *Philosophical Transactions*, entitled "The Diurnal Variation of the Wind and Barometric Pressure at Bombay;" in which, by separating the land-and-sea-breeze from the diurnal variation, the times of maximum and minimum of the North component are obtained probably more accurately, and are given as about 1 p.m. and 0.30 a.m. for the minima, and about 7 p.m. and 6 a.m. for the maxima.

This paper also gives Mr. F. Chambers' theories on the diurnal variation of the wind and of the barometric pressure. A curve shows the supposed diurnal variation of the wind at Bombay when the sea breeze is deducted. It exhibits "a double diurnal right-handed rotation in the same direction as the hands of a watch."

Mr. Chambers points out that Sir John Herschel, in his *Meteorology*, arts. 172 and 77a, has advanced the theory of "a morning and evening tendency of the wind to draw *towards* the points of sunrise and sunset, to compensate the overflow from off the heated atmosphere which takes place aloft in a contrary direction," and also one of "a general movement of air setting *outwards from* the heated hemisphere," together with a single rotation of the wind at any spot, in connexion with the diurnal variation of the barometer, but has not explained the double variation. The theory I suggested in your Magazine, Vol. XXI., p. 121, for 1886, seems virtually the same as the first of Herschel's, just given.

But Mr. Chambers thinks it probable that the movement *from* the heated hemisphere is more marked than the opposite movement, and that if we suppose oscillatory movements to follow the disturbance of equilibrium thus caused, we have a likely explanation of the diurnal variations at Bombay. He also examines the variations at Sandwick (in the Orkneys) and at Falmouth and Toronto, and finds decided support to his theory in the former, and to some degree in those at Falmouth and Toronto. The daily wind *veers*, on the whole, at all these places. As there are decided differences between the places named, and also between them and this north-east coast, is it not possible that one kind of breeze may be strongest at one place and another at another? Are not more observations required, especially in the centres of continents or islands? All the places named are on the shores of seas or lake, which circumstance complicates the phenomena with the addition of sea and land breezes.

Possibly further investigations have been made since the date of Mr. Chambers' paper, but in any case his facts seem not to be generally known.—Yours truly,

T. W. BACKHOUSE.

Sunderland, April 9, 1887.

REVIEWS.

Jahrbuch des K. Sächs. Meteorologischen Institutes, 1885. CHEMNITZ, 1886; la. 4to. with plates.

THIS volume, containing the observations for the year 1885, is the third of the new series of the publications of the Meteorological Office of Saxony. The first section (74 pp.) contains, as in previous years, the observations taken thrice daily at eleven stations of the second order. The synoptic Weather Charts, which previously formed part of this section, are now published in a separate volume, which we think is a decided improvement. The second division (64 pp.) contains the monthly results of 27 stations for each of the years 1876-81, for three hours daily, arranged in a convenient form for use. These tables fill up the gap which existed between the observations published by the late Dr. Bruhns and those by Dr. P. Schreiber, the present very able director. Dr. Bruhns published the results up to 1875, and the new series began with 1882, so that up to the present time the results for 1876-81 were missing. Part III. (138 pp.) contains the Administration Report of the Office for the year 1885, together with nine Appendices, being partly results of observations and partly communications of general interest, among which we would especially mention (1) a statement of all essential details respecting the stations, the periods of the observations, and the positions of the instruments from 1863-85. These particulars are of much value, as although we trust the Central Offices to render their observations as reliable as possible, yet it is more satisfactory that this information should be plainly stated as in the work now before us. (2) Monthly Rain Charts for 1885, and (3) a very comprehensive "Contribution to the Climatology of Saxony," dedicated to the memory of Dr. C. Bruhns. From this discussion we extract the following *average* values, calculated from observations at various stations in Saxony and for a series of years :—

	Rainfall (inches.)		Temp. Fahr.		Rainfall (inches.)		Temp. Fahr.
January	1·45	...	29°·7	August	2·78	...	60°·9
February	1·66	...	31 ·8	September	2·07	...	55 ·8
March	2·01	...	34 ·9	October	2·13	...	45 ·5
April	1·78	...	44 ·1	November	2·08	...	36 ·5
May	2·41	...	52 ·0	December	2·13	...	30 ·6
June	3·38	...	58 ·6				
July	3·14	...	62 ·8	Year	27·02	...	45 ·3

The influence of the mountains in increasing the rainfall at some of the stations is clearly shewn in the various tables, while as regards temperature it is shewn that a difference of elevation of the stations does not always cause a lower temperature; the contrast between town and country, and mountain and valley, sometimes quite masks the recognised law of decrease of temperature with height.

We observe that Dr. Schreiber has broken through the rules laid down by the International Congresses, with respect to the arrangement of the observations, and has also changed the hours from 6, 2, 10 to 8, 2, 8, whereby comparisons with previous publications by

Dr. Bruhns are prevented. But for these important exceptions, we could not speak too highly of this valuable year book.

J. S. HARDING.

Die Meteorologie der Sonne und die Wetterprognose des Jahres, 1886. Von Prof. K. W. ZENGER. 8vo., xii.-52 pages, and one heliogravure. Prag, 1887.

WE consider that the methods of solar photography to which Prof. Zenger has devoted himself for upwards of ten years ought to have been examined and reported upon fully and carefully. We do not think that Mr. Whipple would regard his abstract of Prof. Zenger's "Die Meteorologie der Sonne" as fulfilling these conditions, yet we are not aware that the subject has been elsewhere dealt with. Prof. Zenger may be entirely wrong, but if so, surely the right thing is for some one to prove him to be so and thus save time and thought in the future. The matter is very simple. In, or about, 1875 Prof. Zenger took some photographs of the Sun, and instead of getting a clear image he got one with wings, halos, and other appendages. It appeared to him that there was a distinct relation between these appendages and the weather which followed. He has continued to take these photographs almost every day for 12 years, and they are the basis of the pamphlet before us and of the one abstracted by Mr. Whipple in the "Quarterly Journal of the Royal Meteorological Society," vol. xii., p. 215. Mr. Whipple adds the following short note :—

"A close examination of the Kew Solar Photographs taken almost daily for more than ten years, has not revealed the presence in any of them of the appearances described by Prof. Zenger. Halo-like forms, due to irradiation or halation have been easily produced as an experiment, by over-exposing a prepared plate, even when the luminous source was but a candle. These are due to the glass plate supporting the sensitive surface; and it has been suggested to Prof. Zenger that he should employ paper or films in his future experiments in order to avoid this source of uncertainty in his results."

We have not a copy of "Die Meteorologie der Sonne," but we have had the pleasure of meeting Prof. Zenger more than once, we have seen and possess copies of many of his photographs, and we are most desirous on the one hand that he should have fair play, and on the other hand that if his photographs represent simply bad photography they should be branded accordingly. Mr. Whipple's opinion is tolerably apparent from the above note, but there are some remarks to be made upon it. The first is that the Kew photographs do perfectly that which they are intended to do, viz., represent the surface of the sun; but the sun's disc fills nearly the whole plate, while in the Prague photographs the peculiar appearances occupy a space at least twice as large as the sun itself, consequently they would be *outside* the plates used at Kew. We are not arguing that the Prague photos represent real phenomena—we express no opinion on that—but we do hold that similar appearances on the Kew plates were not to be expected. We rather gather from the present pamphlet that Prof. Zenger has adopted Mr. Whipple's suggestion and employed paper, and still obtains these blurred images

The apparatus used by Prof. Zenger is, we believe, both small and inexpensive; surely one or two skilled photographers will volunteer to bring matters to a crisis. For instance, if the appearances are due to real atmospheric or solar conditions, it is evident that two photos taken at the same place and at the same instant of time are bound to be alike; if the appearances are due to bad photography they ought to differ. Whether or not they are real weather indicators will be evident by comparing a set for even a month with the daily weather reports. Doubtless Prof. Zenger would prefer that the comparison should be made upon the lines adopted in his latest book, *i.e.*, picking up all the exceptional phenomena which occur on the right dates in any part of the world, but with so large an area to gather from, one could find a thunderstorm, snowstorm, cyclone, or flood on any date that one desired, and could thereby justify any prediction that could be made.

In the interest both of meteorology and of Prof. Zenger, we hope that some one, who has no preconceived views to push, and whose sole aim is to find out the truth, will write to Prof. Zenger at Prague, procure the necessary apparatus and publish the results obtained.

Über den Auf-und Zugang der Gewässer des Rustischen Reiches. BEARBEITET VON M. RYKATSCHEW. 4to., iv.—312 pages, 3 maps. [2nd supplementary volume to the Repertorium für Meteorologie.] Eggers and Co., St. Petersburg, 1887.

THE reputation of Dr. Wild's Repertorium is level with, if not above, that of any meteorological publication in the world, and the present volume is well worthy of the series. There are many things which are done abroad which we are either too lazy or too uninterested to do. One of these is to notice the dates at which our rivers are frozen in the autumn and open for navigation in the spring. Of course we may be told that in the British Isles many winters pass without any river being frozen and that the phenomenon is too rare and of too little commercial import to be worthy of note. Perhaps so; but although we are aware that bridges, drainage, and other engineering operations have changed the *régime* of many rivers we still hold that a series of records of the dates at which any one part of any one river was frozen would be of considerable utility. But however this may be for ourselves, the matter is a very vital one for Russia, and in the volume before us it receives most careful and elaborate examination.

It is quite impossible in a short notice to do justice to this work, but we may indicate the nature of its contents by giving a partial summary of the data for one of the shorter rivers—the Onega for example, which flows from south to north and empties itself into the White Sea. There are six sets of observations, comprising altogether 170 records of the date of the ice breaking up and 147 of the river becoming ice-bound. The following is an epitome of the information.

Station.	Lat.	Lon.	Altitude. feet.	Period. years.	Average. Open.	Average. Close.	Ice free. days.
Kargopol	61°30′	38°58	410	21	April 16	Nov. 2	200
Bereshnodubrowsk.	62 9	39 21	308	11	,, 27	?	...
117 miles from Sea..	62 50 ?	40 0 ?	115 ?	16	,, 30	?	...
98 ,, ,, ,,	62 55 ?	39 25 ?	98 ?	7	May 3	?	...
Turtschassow	63 7	39 15	82 ?	30	,, 3	Nov. 15	196
Onega	63 54	38 8	0	87	,, 10	,, 23	197

But it must be understood that the whole of the data are given *in extenso*, so that nearly four quarto pages are devoted to this one medium sized river. Some of the larger ones, the Wolga for instance is reported upon from 54 stations, and occupies between 20 and 30 pages. Altogether there are about 23,000 records from 921 stations from the year 1530 to 1880. And the book unlike some that we could name is not a mass of figures for some hypothetical Newton to work up—but is complete in itself, and accompanied by three large maps, showing by "Isopektiken"* or lines of synchronous freezing, by "Isotaken,"† or lines of synchronous thawing, and "Isopagen,"‡ or lines of equal duration of frost-boundness, the results indicated by all the mass of data here collected.

The only suspicion which has crossed our minds is, whether the observers all had the same idea of the closing and opening of the rivers. There may be somewhere in this large book a clear definition and a reference to the instructions given to the observers, but we have not seen it, and if no such instructions have been given (which we are loth to believe is the case in recent years) we hope that they will be issued forthwith. As regards 1530, 1609, 1739 and such like dates, it is hardly likely that the instructions were very precise.

However, this will doubtless be discussed in the second portion of the work, viz., that dealing with secular changes which we are glad to see M. Rykatschew promises us. He almost always gives us valuable information and the present work is an excellent specimen.

The Journal of the National Fish Culture Association, edited by J. W. Willis Bund, M.A., F.L.S. Vol. I., No. 1; 8vo., 83 pages. London: Blackfriars Printing and Publishing Company.

We bid this new periodical a hearty welcome, because its primary object is the good and useful one of "Collecting and publishing periodically reports and information from this and other countries on fish culture and fisheries." The present number has a special claim upon the patronage and attention of meteorologists, because it contains probably the best article ever written upon "The influence of Weather on the Migration of Fish," by Mr. J. W. Willis Bund. We shall not epitomise this paper, but leave our fishermen readers to buy a copy or to join the association and so get one for nothing.

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* ἰσοπηχτιχός equally fastened. † ἰσοτήχω equal melting.
‡ ἰσοπάγος equally a concrete mass.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, OCT., 1886.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0-10
England, London	78·8	4	39·6	14	60·3	47·8	49·3	86	112·2	32·3	2·43	23	6·2
Malta	88·4	20	62·3	16	78·5	67·8	63·7	75	145·7	58·0	·64	4	4·9
Cape of Good Hope	...	...	...	...	...	...	...	..	...	...	...	...	...
Mauritius	81·0	7	61·0	3	77·7	66·5	60·5	71	131·2	49·5	2·58	23	5·9
Calcutta	89·5	13*a*	73·5	31	87·7	76·9	76·6	86	159·3	68·1	3·91	12	4·9
Bombay	90·4	29	74·2	25	85·7	76·9	75·7	83	150·6	68·8	1·69	7	5·4
Ceylon, Colombo	87·7	19	71·8	26	85·5	76·1	72·4	75	147·0	68·5	16·07	20	6·9
Melbourne	75·5	28	38·6	8	63·5	45·9	44·6	70	126·8	31·0	2·84	16	6·5
Adelaide	79·3	27	39·5	13	68·1	48·6	44·8	60	135·8	30·7	2·17	19	4·8
Wellington	66·5	23	37·0	31	57·3	46·8	45·9	80	134·0	33·0	5·63	21	4·3
Auckland	68·5	26	44·0	16	62·3	51·1	49·3	76	132·0	35·0	3·42	17	6·9
Jamaica, Kingston	96·4	1	66·0	17	92·4	72·1	72·0	81	...	...	3·90	14	5·6
Barbados	84·0	var.	71·0	var.	82·0	73·0	72·0	80	143·0	...	11·65	19	6·0
Toronto	...	...	...	...	...	...	...	...	...	...	...	...	...
New Brunswick, Fredericton	...	...	...	...	...	...	...	...	...	...	...	...	...
Manitoba, Winnipeg	...	...	...	...	...	...	...	...	...	...	...	...	...
British Columbia, Victoria	...	...	...	...	...	...	...	...	...	...	...	...	...

a And 15, 17.

REMARKS, OCTOBER, 1886.

MALTA.—Mean temp. 72°·1 ; mean hourly velocity of wind 10·0 miles. Sea temp. fell from 78° to 68°. The three days, 19th to 21st, were unusually hot, and orange trees were much damaged. J. SCOLES.

Mauritius.—Rainfall ·90 in. above, mean temp. of air and of dew point slightly below average ; mean hourly velocity of wind 13·1 miles, 1·1 miles above average ; extremes 30·2 miles, and 3·1 miles ; prevailing direction E. by S. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 2°·2, and of dew point 1°·7, mean pressure ·113 in., and rainfall slightly below their respective averages ; mean humidity, average ; mean amount of cloud slightly above average. Prevailing winds S and N., strong on seven days ; H on two days ; T on three days ; L on two. R. L. J. ELLERY, F.R.S.

Adelaide.—The coldest October ever experienced in Adelaide ; mean temp. 3°·6 below the average of 29 years. Rainfall ·42 in. above average ; pressure slightly below average. C. TODD.

Wellington.—On the whole a showery, unpleasant month, frequently stormy, with prevailing N.W. wind. Rainfall ·81 in. above, and mean temp. 1°·6 below the average. T and vivid L on 25th. Earthquakes on 11th, at 4·12 p.m. slight, and on 13th about 8·30 p.m., very slight. R. B. GORE.

Auckland.—A cold, showery and unsettled month ; pressure, mean temp. and rainfall all slightly below the average. T. F. CHEESEMAN.

Barbados.—Pressure steady ; mean temp. (76°) about the average ; mean hourly velocity of wind six miles ; rainfall considerably above the average. TS on 2nd. Five days more or less overcast. R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, MARCH, 1887.

[For the Counties, Latitudes, and Longitudes of most of these Stations, see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	2·03	XI.	Castle Malgwyn	2·32
,,	Margate, Birchington...	1·37	,,	Rhayader, Nantgwillt..	4·15
,,	Littlehampton	·89	,,	Carno, Tybrith	2·58
,,	Hailsham	1·43	,,	Corwen, Rhug	1·72
,,	Ryde, Thornbrough	1·06	,,	Port Madoc	2·88
,,	Alton, Ashdell.....	2·32	,,	I. of Man, Douglas	1·81
III.	Oxford, Magdalen Col...	1·58	XII.	Stoneykirk, Ardwell Ho.	1·70
,,	Banbury, Bloxham	1·51	,,	New Galloway, Glenlee	1·71
,,	Northampton	1·37	,,	Melrose, Abbey Gate...	1·84
,,	Cambridge, Beech Ho...	1·26	XIII.	N. Esk Res. [Penicuick]	1·95
,,	Wisbech, Bank House..	1·46	XIV.	Ballantrae, Glendrishaig	1·84
IV.	Southend	...	,,	Glasgow, Queen's Park.	1·66
,,	Harlow, Sheering	1·16	XV.	Islay, Gruinart School..	2·42
,,	Rendlesham Hall	1·15	XVI.	St. Andrews, Pilmour Cot	1·15
,,	Diss	1·98	,,	Balquhidder, Stronvar..	2·57
,,	Swaffham	2·01	,,	Dunkeld, Inver Braan..	1·45
V.	Salisbury, Alderbury...	1·39	,,	Dalnaspidal H.R.S. ...	2·72
,,	Warminster	2·87	XVII.	Keith H.R.S.	·79
,,	Calne, Compton Bassett	2·03	,,	Forres H.R.S.	·89
,,	Ashburton, Holne Vic..	3·25	XVIII.	Strome Ferry H.R.S....	2·96
,,	Holsworthy, Clawton...	1·19	,,	Tain, Springfield.....	...
,,	Hatherleigh, Winsford.	·77	,,	Loch Shiel, Glenaladale	5·13
,,	Lynmouth, Glenthorne.	2·03	,,	S. Uist. Ardkenneth ...	1·64
,,	Probus, Lamellyn	2·02	,,	Invergarry	2·72
,,	Wincanton, Stowell Rec.	2·32	XIX.	Lairg H.R.S.	...
,,	Taunton, Lydeard Ho...	1·66	,,	Forsinard H.R.S.	1·04
,,	Wells, Westbury.....	1·81	,,	Watten H.R.S.	·34
VI.	Bristol, Clifton	2·38	XX.	Dunmanway, Coolkelure	3·63
,,	Ross	1·50	,,	Fermoy, Gas Works ...	1·77
,,	Wem, Clive Vicarage ...	1·54	,,	Tralee, Castlemorris ...	1·45
,,	Cheadle, The Heath Ho.	1·78	,,	Tipperary, Henry Street	1·51
,,	Worcester, Diglis Lock	1·16	,,	Newcastle West	·39
,,	Coventry, Coundon	1·70	,,	Miltown Malbay.....	1·10
VII.	Melton, Coston	1·61	XXI.	Gorey, Courtown House	1·85
,,	Ketton Hall [Stamford]	1·65	,,	Navan, Balrath	1·12
,,	Horncastle, Bucknall ...	1·42	,,	Mullingar, Belvedere ...	1·12
,,	Mansfield, St. John's St.	1·87	,,	Athlone, Twyford	1·57
VIII.	Macclesfield, The Park.	1·80	,,	Longford, Currygrane...	1·16
,,	Walton-on-the-Hill.....	1·42	XXII.	Galway, Queen's Coll...	1·27
,,	Lancaster, South Road.	...	,,	Clifden, Kylemore	1·58
,,	Broughton-in-Furness ..	2·62	,,	Crossmolina, Enniscoe..	1·88
IX.	Wakefield, Stanley Vic.	1·04	,,	Collooney, Markree Obs.	1·79
,,	Ripon, Mickley	1·74	XXIII.	Rockcorry.....	1·12
,,	Scarborough.....	1·96	,,	Warrenpoint	·96
,,	East Layton [Darlington]	2·16	,,	Newtownards	...
,,	Middleton, Mickleton ..	1·42	,,	Belfast, New Barnsley..	1·56
X.	Haltwhistle, Unthank..	2·41	,,	Cushendun	2·10
,,	Shap, Copy Hill	1·53	,,	Bushmills	1·91
XI.	Llanfrechfa Grange	2·99	,,	Stewartstown	1·00
,,	Llandovery	2·69	,,	Buncrana	2·00

MARCH, 1887.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg	Date	Min. Deg.	Date.	No. of Nights below 32°. In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	1·65	+ ·04	·37	15	12	57·5	27	22·4	14	16	20
II.		Maidstone (Hunton Court)...	1·89	+ ·31	·33	15*j*	14	...	...	...	...	...	...
,,		Strathfield Turgiss	1·70	+ ·30	·45	15	11	57·4	29	15·2	19	15	24
III.		Hitchin	1·36	— ·12	·34	31	13	53·0	29*a*	20·0	16*d*	17	...
,,		Winslow (Addington)	1·66	— ·10	·34	31	12	56·0	27*b*	18·0	13*g*	17	26
IV.		Bury St. Edmunds (Culford)	1·90	+ ·34	·49	31	12	56·0	28	17·0	12*h*	23	...
,,		Norwich (Cossey)	2·05	+ ·36	·51	31	11	...	...	...	...	...	...
V.		Weymouth(LangtonHerring)	1·27	...	·25	22	10	56·0	30	23·0	17	15	...
,,		Barnstaple	1·69	— ·80	·40	22	10	60·5	30	21·0	14	...	...
,,		Bodmin	2·08	— 1·08	·73	22	10	54·0	30	30·0	14	...	...
VI.		Stroud (Upfield)	1·44	— ·37	·31	22	12	58·0	27	20·0	13	18	...
,,		ChurchStretton(Woolstaston)	1·62	— ·54	·43	22	16	55·0	29	19·0	17	18	23
,,		Tenbury (Orleton)	1·37	— ·50	·27	22	13	59·7	29	16·8	14	20	...
VII.		Leicester	1·82	...	·45	22	14	58·8	29	21·0	13	17	30
,,		Boston	1·17	— ·12	·26	23	10	67·0	29	20·0	14	17	...
,,		Hesley Hall [Tickhill].....	1·38	...	·39	11	13	59·0	29	19·0	18	16	...
VIII.		Manchester (Ardwick).....	1·77	— ·68	·51	22	9	50·0	29*c*	24·0	13*g*	16	...
IX.		Wetherby (Ribston Hall) ...	1·47	— ·76	·59	23	7	...	...	...	...	...	...
,,		Skipton (Arncliffe)	3·17	— 1·59	·84	22	15	53·0	4	23·0	3	9	...
,,		Hull (Beverley Road)	1·52	— ·28	·35	11	19	58·0	29	23·0	17	15	18
X.		North Shields	1·82	+ ·37	·50	11	15	58·5	29	18·5	17	17	19
,,		Borrowdale (Seathwaite).....	4·52	— 5·37	1·33	26	12	54·0	5	20·0	13	14	...
XI.	WALES.	Cardiff (Ely).....	2·57	— ·12	·70	14	10	...	...	...	...	...	...
,,		Haverfordwest	2·32	— ·87	·66	22	10	58·0	...	21·0	12	22	26
,,		Plinlimmon (Cwmsymlog) ...	2·70	...	·76	26	12	...	...	...	...	...	...
,,		Llandudno.....	1·83	— ·05	·39	14	8	51·0	5	26·4	17	11	...
XII.	SCOTLAND.	Cargen [Dumfries]	1·33	— 1·45	·46	11	7	57·4	30	20·0	15	14	...
,,		Jedburgh (Sunnyside).....	1·71	+ ·14	·48	13	12	58·0	30	10·0	13	19	...
XIV.		Old Cumnock	2·53	— ·40	·45	10	14	57·0	30	13·0	13	18	...
XV.		Lochgilphead (Kilmory)	3·54	— 1·07	·68	12	15	...	...	...	...	...	...
,,		Oban (Craigvarren)	2·13	...	·58	26	12	57·9	30	25·0	12	8	...
,,		Mull (Quinish).....	3·54	...	·69	10	20	...	...	...	...	...	...
XVI.		Loch Leven Sluices	1·90	— ·22	·7	11	10	...	...	...	...	...	...
,,		Arbroath	1·69	+ ·06	1·17	10	8	58·0	2*c*	18·0	12	12	...
XVII.		Braemar	1·32	— ·87	·63	10	15	55·2	22	16·2	16*i*	22	28
,,		Aberdeen	2·11	...	·42	10	16	61·0	3	19·0	15	16	...
XVIII		Lochbroom	1·75	...	·38	27	14	...	...	...	...	...	...
,,		Culloden	1·13	— ·62	...	...	...	55·0	2	17·0	12	11	22
XIX.		Dunrobin	...	...	...	...	...	...	...	...	...	...	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	..	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	1·96	— ·80	·60	21	9	62·0	29	24·0	16	11	...
,,		Dromore Castle	2·38	...	·55	10	11	60·0	29	25·0	17	...	...
,,		Waterford (Brook Lodge) ...	1·82	...	·80	22	12	57·0	28	24·0	17	13	...
,,		O'Briensbridge (Ross)	1·24	...	·28	11	11	55·0	30	27·0	13	13	...
XXI.		Carlow (Browne's Hill)	1·24	— ·87	·56	22	11	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	1·49	— ·24	·59	11	15	55·8	28	25·8	13	8	26
XXII.		Ballinasloe	1·28	— 1·10	·25	24	12	54·0	29*c*	21·0	13*d*	19	...
XXIII		Waringstown	1·31	— ·75	·30	24	17	64·0	30	20·0	12	15	23
,,		Londonderry (Creggan Res.).	1·94	...	·50	24	19	...	...	...	...	...	...
,,		Omagh (Edenfel)	1·22	— ·87	·45	24	13	55·0	30	22·0	12	17	20

a And 30, 31. *b* And 29. *c* And 30. *d* And 18. *g* And 14. *h* And 13, 18. *i* And 17. *j* And 22.
+ Shows that the fall was above the average ; —that it was below it.

METEOROLOGICAL NOTES ON MARCH, 1887.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—Severe wintry weather characterized the month, with S storms and bitter nights. On some days there was bright warm sunshine for a few hours. S on three days. H on two days. Wheat crop in excellent condition. Honey bee first seen on 11th, peacock butterfly on 25th.

ADDINGTON.—A fine month for the land. A very cold period occurred from 12th to 21st, and there were many severe frosts. Prevailing winds E. and N.E. Dense fog on 1st and 4th; four inches of S on 15th.

CULFORD.—An unusually severe month, and all vegetation very backward; fog on two days, S on four days.

LANGTON HERRING.—A very fine month; R or S fell on only ten days, and the total is ·54 in. below the average of 12 years. With the exception of 1883, the coldest March in 16 years, the mean temp. being 4°·8 below the average; for eight days (13th–20th), the temp. never reached 40°, and at 9 a.m. on 17th, it stood at 27°, the lowest recorded at that hour in March during 16 years. Pressure generally high, and range slight. Severe S.W. gale on night of 22nd; solar halo on 17th; fog on two days.

BODMIN.—A very dry month, with much sunshine. Mean temp. 38°, 6°·6 below the average.

STROUD.—Slight S fell on 12th, and lay on the hills for an hour or so; and on night of 14th, 3 inches fell, and 3 inches more fell on 15th.

WOOLSTASTON.—Another month of continued frost. S fell on seven days. Mean temp. 30°·6.

ORLETON.—A very cold and dry month, with severe frosts almost every night, and slight falls of S at intervals till the 22nd, when the wind changed towards the S. for a few days, and the remainder of the month was milder. Fogs were frequent at the beginning of the month and there was a great darkness about 8.30 a.m. on the 10th. A great wind blew on the night of the 31st. Mean temp. more than 4° below the average of 26 years, and the lowest in that period with the exception of 1867 and 1883. The land was very dry and favourable for all farming operations, which were only checked by the severe frost. A little S on 12th, and the hills covered on 13th. About an inch of S on 14th, and another inch on 15th, an inch and a half on 22nd, and slight falls on other days.

ARDWICK.—March commenced rather cold, but fine, and there were many frosty mornings with low temperature; the latter part was cold, with snowfalls, R and wind.

HULL.—A cold month, with much frost and S, from 11th to 21st.

NORTH SHIELDS.—S on 11 days. Fog on four days.

WALES.

HAVERFORDWEST.—Great dryness of the air, much sunshine, and severe frosts were the characteristics of the month. Wind E. and E.N.E. Rainfall small, except on the mountains. No S.

LLANDUDNO.—The old adage as regards the weather in March, was literally fulfilled. It came in like a lamb, and went out like a lion. For the first ten days there was not a drop of R; though a few of these were dull, they were all decidedly calm and very enjoyable. A moderate S.W gale blew on 22nd, but with this exception there was no noteworthy atmospheric disturbance till the 31st, when about 5 p.m. the wind which was W. gradually veered to N., and blew with great force during the whole night. Though S was visible on the distant hills during a considerable portion of the month, very little fell at Llandudno, and the little that did fall soon melted. S and sleet fell on 13th and 14th, and H on 22nd. The mean temp. (40°·3) is 3°·1 below the average. There was a fair amount of sunshine, and notwithstanding a somewhat low temperature the month as a whole was seasonable and fine.

SCOTLAND.

CARGEN.—Very cold weather prevailed for about ten days in the middle of the month, the mean temp. from 12th to 21st being 33°·6. Mean temp. of the month, 1° below average. Sunshine 36 hours below average; E. winds prevailed on 15 days. S 3 inches deep on 11th.

JEDBURGH.—The weather as a whole was cold and ungenial, but while there was little vegetation the cold winds were favourable for drying the earth for seed sowing. S on six days, seven inches deep on 12th.

ABERDEEN.—For upwards of a week at the beginning of the month no R fell, but this was succeeded by a severe S storm, which continued for a week, with low night temp. Rainfall about the average. Aurora was seen on three nights, and a violent N.W. gale blew on 31st, accompanied by S and sleet.

LOCHBROOM.—The first nine days of the month were like summer, but the remainder of the month was very variable, and at times very severe, with S on several days.

CULLODEN.—The weather during the month was dry, no R falling between the 1st and 19th, and the temp. was low throughout.

IRELAND.

CORK.—March was fine and dry to the 10th, then "many weathers" during the remainder.

DROMORE.—A very fine month.

WATERFORD.—A hard dry month, good weather for farm work which is very forward. S on four days, and the Comeragh mountains covered from 23rd to 25th. Fog on four days.

O'BRIENSBRIDGE.—A month of extraordinarily fine weather.

DUBLIN.—The month was very cold—at first dry, then snowy and finally squally and showery with the exception of the 29th and 30th. Mean temp. 41°·3, about 2° below the average, 1°·6 below that of February, and 0°·2 below that of January. Prevailing winds N.W., W., and N.E; mean humidity 82, mean amount of cloud 6·1.

BALLINASLOE.—Rainfall less than half the average of 14 years. A whirlwind and two waterspouts occurred on the 10th inst., one at 2.20 p.m., and the other at 4.15 p.m.

EDENFEL.—Up to the 9th the weather was of the unprecedentedly fine character that marked the month of February, many of the days were clear, calm and balmy, and even during the second week—a severe one in many parts—there was nothing here to disturb ordinary agricultural operations. From the 22nd to 27th, equinoctial disturbances with sleet and R squalls recalled for the first time the usual March character, but the month went out as fine as it began.

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