consider the former, in the public schools, sins of commission rather than sins of omission are usually the occasion of bad marks in deportment. It is usually the active, energetic boy, the one with vitality to spare, who gets the demerits. The anemic youngster may never stand at the head of his class, but he is very likely to delight his fond mamma with a mark of 100 in deportment. If that be so, and I speak with authority upon this point if upon no other, disorder in the school room is an active thing, and an evidence of excessive vitality. With the penitentiary inmate I have had less experience, but upon *a priori* grounds would argue that what is true for the child in question of deportment would not be radically different for the adult.

With persons arrested for the crime of assault and battery the same is, I believe, demonstrably true. One might feel like fighting and perhaps more frequently does feel so when possessed of "that tired feeling" which is the fortune of patent medicine venders, but to feel like fighting without doing so, never brought a man before the police judge for the crime which we are considering. There must be both the inclination and the consciousness of strength to back it up before one would be likely to figure in this class of data.

In the case of arrests for insanity, we shall take the word of the psychiatrist that acute mania increases with any condition which tends to augment the output of nervous energy. The daily fluctuations in strength which all have experienced are not so much those of physical as of nervous energy (if this distinction may be made), and with any persons having tendencies to mania the results would be those which our records show.

But to return to those activities of life which vary in an opposite way to those just discussed. In the long run, absence from school is an indication of physical disability. In the case of drunkenness, it seems to me beyond a doubt that with the several classes from which my data were secured the problem of vital energy enters in and that excessive drunkenness is an indication of its depletion. We may, I believe, with justice conclude that many of the habitués of the police court as prisoners struggle against their tendencies to drink, knowing the consequences. When vitality is excessive they do so with success, for days and perhaps for weeks they are winners, but finally the time comes when the fight is too severe and they succumb. That was the day when vitality was at its lowest ebb.

If, then, this general analysis be a correct one, the various meteorological conditions produce a direct result upon the metabolic processes of life, some of them tending to accelerate the production of vital energy, others to retard the process. For the want of better terms, though fully recognizing the inexactness of their application, I shall use the term anabolic as indicative of the former, katabolic the latter.

To consider very briefly the exact effects of the various meteorological conditions. Low temperatures seem generally katabolic, with gradually increasing anabolic tendency until a mean temperature of about 85° F. is reached, when a sudden change takes place and the effect upon available energy is disastrous. At this point active disorder reaches its minimum, while the death rate, suicide, and clerical error increase to an alarming extent. Low barometric pressure is anabolic in its effect, with the reverse for a higher mercurial column. As to conditions of relative humidity, a dry atmosphere is uniformly exhilarating (anabolic), while a moist one is correspondingly depressing. For no other one of the meteorological conditions is the effect so marked. A study which I made of the deportment of children in the public schools of Denver, Colo., where the prevailing condition is one of low humidity, but where occasionally atmospheric moisture reaches almost to the zero point, demonstrated that upon such successively dry days active disorder ran up to more than seven times the normal. For conditions of wind, strangely enough, calms are found to have a katabolic effect of tremendous magnitude in New York City. During their prevalence the death rate is abnormally high, and there are three times the normal number of absentees among the school children. At the same time the police courts practically go out of business. It seems probable to me that these conditions are practically the results of poor ventilation on a large scale.

For days of different character, as determined by the sunshine recorder and also by precipitation, we find influences such as would most naturally be expected; i. e., anabolic for the clear and dry, with the opposite for those of the other character. Deportment, however considered, is at its best on the cloudy, wet days, while the death rate is high. Suicide, however, here shows a peculiar anomaly in that it is excessive on the bright, dry days.

Some interesting facts not already alluded to are suggested by my studies, and in conclusion I mention two of them:

First. There would seem to be reason to infer that the influence of the state of the weather upon children is more marked than that upon adults.

Second. That women seem to be more sensitive to such influence than men. Evidences of this are to be found in the study of arrests for assault and battery, where the sexes were tabulated separately.

In explanation of my own conception of the whole problem of weather influences, I would say, in closing, that we can not suppose peculiar meteorological conditions to be the immediate cause of many of the abnormalities of conduct which vary with them. I have determined that suicide is much more frequent when the barometer is low than when it is high, yet would not wish to assert that low barometrical conditions ever drove a man to self-destruction. The only thing supposable is that during such atmospheric conditions the general emotional states are of such qualities that other things are more likely to do so.

This would be just as true for any of the other abnormalities of conduct studied. We can, on the strength of the whole series of studies, claim to have demonstrated that the metabolic processes of life to some extent vary with the weather states and that these variations in metabolism make themselves evident both through physiological and psychological manifestations. More than this we do not at present claim.

ELASTICITY AT LOW TEMPERATURES.

By J. R. BENTON, Ph. D. (Göttingen, 1900), dated Washington, D. C., February 20, 1903.

The subject of elasticity of solids has perhaps a less direct interest for the meteorologist than some other branches of science; it must, however, claim some attention on account of the use of numerous meteorological instruments whose action depends on the elasticity of springs. It is important to know how the indications of Vidi aneroids and Bourdon pressure gages, of air thermometers, and of pressure anemometers are affected by changes of temperature producing changes in the elasticity of important parts of these instruments. Since in making observations at great altitudes, the meteorographs are exposed to very low temperatures, it is desirable, in particular, to know how elasticity is influenced by extreme cold.

But few general statements can be made in regard to the variation of elasticity with temperature. In almost all substances the elasticity decreases with rising temperature; yet this general rule has an exception in the case of vulcanized india rubber, which, under certain conditions, becomes more elastic as its temperature increases. It is a general rule, also, though not a universal one, that the rate of change of elasticity with temperature, for a given substance, is greater as the temperature is higher. Comparing different substances, we find that, in general, a given change of temperature (say from 0° to 1°) produces the greatest change in elasticity in those substances which are nearest to their melting points, and the least change in those which are farthest from their melting points.

Excepting such rough qualitative rules as the above, we can not, in the present state of science, make any *a priori* statements regarding the effect that a given temperature may be expected to have on the elasticity of a given substance. The only way by which we can obtain reliable and exact knowledge on this point is by direct experiment.

Many experiments have been made on elasticity at temperatures above the ordinary, and a few at temperatures as low as —15° C. (5° F.). Until lately no experiments at lower temperatures had been made, for the reason that, until very recent years, the difficulties in the way of producing lower temperatures have been prohibitive of their use in research. These difficulties have now been overcome by the introduction of methods for producing liquid air in considerable quantitities, and at a cost which, though still great, is within the means of many laboratories. The temperature of liquid air, boiling at atmospheric pressure, is approximately —186° C. or —302° F. Lower temperatures, although attainable, are not yet generally available; and the temperature of liquid air may be regarded at present as a sort of lower limit of temperature, above which numerous and extended investigations of most physical phenomena have been made, but below which only few and isolated researches have yet been carried out.

Prof. James Dewar discovered in 1894 that the strength of metals is greatly increased by the extreme cold of liquid air; and this led him to think that a similar increase in elasticity might take place at low temperatures. He found that such an increase occurred in the case of a wire of fusible metal. The wire was bent into a spiral; at liquid air temperature it supported a weight of two pounds and vibrated like a steel spring, while at ordinary temperatures it was pulled out straight by an ounce weight. Another instance is furnished by india rubber; at ordinary temperatures it offers but little resistance to distorting forces, and consequently has but little elasticity of rigidity; when cooled to liquid air temperature its elasticity is greatly increased, and it becomes stiff and brittle, like glass.

There is no reason, however, to expect that metals like steel and copper increase in elasticity at low temperatures as much as india rubber or fusible metal, because, as stated before, it is the general rule that substances having high melting points vary in elasticity less for a given change of temperature than do those of lower melting points. The melting points of steel and copper may be taken as 2500° F. and 2200° F., respectively; while those of india rubber and of Dewar's fusible metal may be taken as 300° F. and 400° F.

Experiments were carried out by the writer to ascertain how much the elasticity of steel and of copper is changed by cooling to the temperature of liquid air.[1] It was found that the change is a very appreciable one, although, as anticipated, not nearly as great as that observed in Dewar's fusible metal. The numerical results obtained are given in the following paragraph:

At —186° C. or —300° F., Young's modulus for steel is greater than at 20° C. (65° F.) by 8½ per cent; Young's modulus for copper is greater than at 20° C. (65° F.) by 18 per cent; the modulus of torsion of steel is greater than at 20° C. (65° F.) by 7 per cent; the modulus of torsion of copper is greater than at 20° C. (65° F.) by 6 per cent.

These results are exhibited graphically in the accompanying figs. No. 1, 2, 3, and 4, in which the abscissas represent temperatures in centigrade degrees, and the ordinates represent the corresponding values of the elastic moduli, expressed in terms of their values at 20° C. (65° F.); the values at —186° C. are the results of the writer's experiments, those at higher temperatures are taken from the experiments of Pisati and Wertheim.

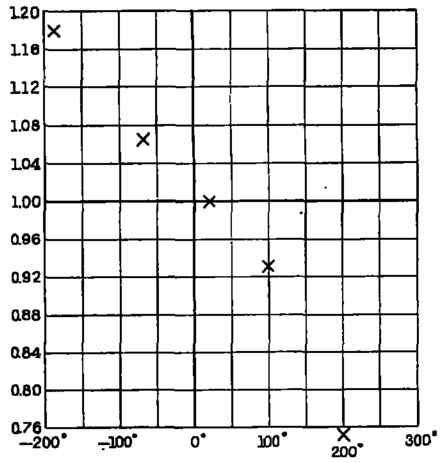

FIG. 1.—Young's modulus of copper, in terms of its value at 20° C. Wertheim's results for high temperatures. My result for —186° C.

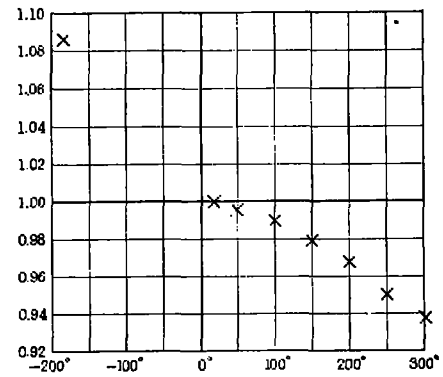

FIG. 2.—Young's modulus of steel, in terms of its value at 20° C. Pisati's results for high temperatures. My result for —186° C.

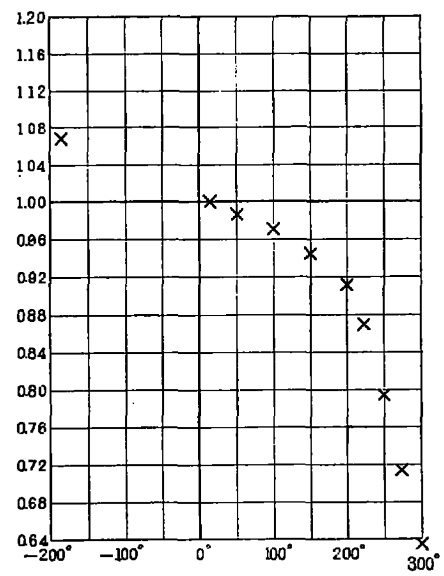

FIG. 3.—Rigidity modulus of hard drawn copper, in terms of its value at 20° C. Pisati's values for high temperatures. My result for —186 C.

Of these results the one most interesting in connection with meteorological instruments is that for the modulus of torsion of steel, since steel is the metal most commonly used in springs, and since elasticity of torsion determines the behavior of a helical spring. This result enables us to calculate what influ-

[1] An account of the writer's experiments is given in the Physical Review. Vol. XVI. January, 1903. Pp. 17–27.

ence low temperature may be expected to have on the indications of an instrument whose action depends on a steel helical spring. The effect of temperature on such instruments is often ascertained more conveniently by trial than by calculation; but when the instrument is to be used at temperatures outside of the limits between which it has been tested, recourse must be had to calculation, usually by extrapolation from the temperatures at which tests have been made. It is always a question how far it is justifiable to carry such extrapolation; for the rate of change with temperature may be very different outside the limits within which tests have been made from what it is inside of them. The writer's experiments show that at low temperatures no very great change takes place in the manner in which the elasticity of steel depends on temperature; and that, therefore, in allowing for the effect of low temperature on an instrument whose indications depend on the action of a steel spring, it is possible to extrapolate from the results of tests at higher temperatures.

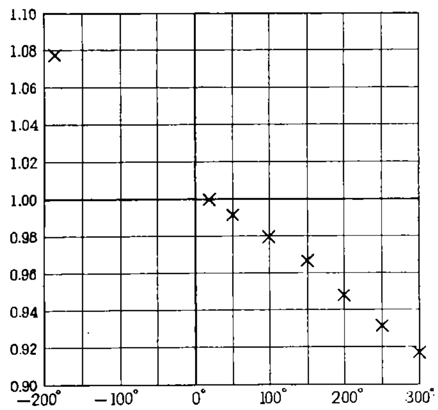

FIG. 4.—Rigidity modulus for steel, in terms of its value at 20° C. Pisati's results for high temperatures. My result for −186° C.

THERMOMETRIC OBSERVATIONS AT SANTA FE, ON THE ISLE OF PINES.

Communicated by E. W. KELLOGG, M. D.

Isle of Pines temperatures during December, 1902.

[Observed with a spirit thermometer.*]

December.	6 a. m.	Noon.	9 p. m.	Weather.	December.	6 a. m.	Noon.	9 p. m.	Weather.
	°	°	°			°	°	°	
1..	74	86	76	Clear.	17..	74	83	75	Clear.
2..	74	87	76	Clear.	18..	72	80	72	Clear.
3..	74	86	76	Clear.	19..	70	79	69	Clear.
4..	76	88	78	Light showers.	20..	71	80	72	Clear.
5..	76	81	76	Partly cloudy.	21..	70	80	72	Clear.
6..	74	82	76	Clear.	22..	65	80	74	Clear.
7..	76	82	76	Clear.	23..	65	75	70	Clear.
8..	72	78	72	Clear.	24..	65	71	68	Clear.
9..	76	80	74	Partly cloudy and clear.	25..	64	70	70	Partly cloudy.
10..	72	81	76	Clear.	26..	69	72	68	Clear.
11..	74	80	76	Light thundershower.	27..	60	73	66	Clear.
12..	72	83	78	Clear.	28..	58	72	67	Clear.
13..	76	85	76	Clear.	29..	67	78	71	Clear.
14..	76	83	76	Clear.	30..	70	78	71	Shower and clear.
15..	75	82	74	Clear.	31..	72	82	72	Clear.
16..	74	83	76	Clear.					

* Nothing is at present known of the accuracy of this spirit thermometer, but it is hoped that the observer will eventually provide a reliable mercurial thermometer and make the necessary comparative readings.—*C. A.*

VIOLENT WIND IN SOUTH DAKOTA.

By S. W. GLENN, Local Forecast Official, dated Huron, January 15, 1903.

The wind, which was from the northwest, attained a maximum velocity of 48 miles per hour; a special observation was taken at 2:40 p. m. of the 6th and sent to the district forecast center. Because of an increase in pressure of .12 inch in two hours, another was taken at 5:20 p. m. and sent; and at 6:20 p. m. another was sent because of a 64-mile per hour wind and a possibility of no wires being available for the regular p. m. report. It was only through the courtesy of the train dispatcher of the Chicago & Northwestern Railway, who had an outlet for about five minutes, that the p. m. report got off.

The a. m. report of the 7th was promptly filed, but it was later learned that it did not get off in time for the St. Paul circuit, so was sent by mail with an explanation relative thereto. There was practically no outlet by wire from the time that the p. m. report of the 6th was sent until the late afternoon of the 7th, due to the wires being down, or in trouble.

On the 7th as soon as a wire was available, a special observation was taken and sent to Chicago, showing the conditions from 8 a. m. up to that time.

After 2:20 p. m. of the 6th the wind steadily increased, with occasionally some abatement for short periods, until about 10:45 p. m. when it attained a maximum velocity of 72 miles per hour, after which time it very slowly diminished, though it continued high most of the 7th.

A number of clippings relative to the storm have already been forwarded, but those applying to Huron and the vicinity are somewhat exaggerated. A portion of the flat tin roof of the Presbyterian College, a four-story structure, was torn away about two hours before the maximum wind velocity occurred, taking with it a portion of the brick coping that was in poor repair, and a portion of the débris knocked down a chimney of a near-by church and also of a residence. Several out-of-repair chimneys were blown down or damaged, and some loose and exposed outhouses were blown over. The south gable of an old one-story building was blown out, due to a draft from an opening on the north side. The roof of the college was a weak affair, and I am informed the wind had access below and under the roof from a broken window.

Farmers in the county report some wind mills with old wooden supports blown down, and hay stacks uncovered.

The Chicago & Northwestern Railway train service was greatly interrupted by the storm, due to snow blowing into the cuts.

In the county adjoining on the east, two men and some animals were reported killed by a shelter being blown in.

The Weather Bureau instrument shelter is fully exposed to the force of the wind from all directions, but the thermograph trace during the storm does not show a very marked vibration.

Fortunately, there was no snow during the storm of any consequence, and the temperature was comparatively moderate during the gale.

The maximum velocity during the storm exceeded by three miles the highest ever before recorded at the station, which was 69 miles per hour in June, 1894, but the wind has equaled or exceeded 60 miles per hour in 21 previous storms.

The total movement from noon of the 6th to noon of the 7th was 1000 miles, or an average of 41.7 miles per hour.

THE VERTICAL COMPONENT OF THE MOVEMENT OF CLOUDS MEASURED BY THE NEPHOSCOPE.

By LOUIS BESSON, translated from the Annuaire, Société, Météorologique de France, 1902, pp. 180-185.

In order to determine by means of a nephoscope the movement of a layer of clouds, it is usually considered sufficient to observe the direction of these from a point in the sky chosen arbitrarily. This is to admit implicitly that—omitting all accidental deviations—the same result would be found at any other point in the sky.

This, however, is not the case. The observations made at Montsouris show that in general the apparent direction of the motion of the clouds varies from one point in the sky to another and that the differences frequently attain a rhumb (22.5°), and even much more. In the great majority of cases the clouds seem to vary from one side to the other of their mean direction.