milliliter being larger than the cubic centimeter by twenty-seven parts in a million.

It is a peculiar fact that although the one-thousandth part of the liter is the unit that is almost universally employed in measurements of volume and density of liquids, it is most often designated as the "cubic centimeter" or "cc" instead of by its correct designation "milliliter" or "ml." While the two units are so nearly equal as to be interchangeable for many purposes, yet the difference between them is sufficient to be very troublesome at times.

The only safe procedure is always to make sure which unit is being employed and then to designate it correctly. The preferable designation is "cm^3" for the cubic centimeter and "ml" (not "cc") for the milliliter.

It is unfortunate that the kilogram should not have been made a little lighter or the meter a little longer in order that the cubic decimeter and liter might have been equal and the original plan of interrelation of the units carried into effect.

H. W. BEARCE

BUREAU OF STANDARDS,
WASHINGTON, D. C.

THE PASSING OF THE CIRCUIT SYSTEM OF COLLECTING WEATHER REPORTS

ON April 1, 1928, the Western Union Telegraph Company abandoned the circuit system, inaugurated in 1871 and used continuously since in collecting the twice-daily weather-reports from points in the United States and Canada.

A new and more flexible system was installed which obviated the necessity of withdrawing twice daily about 15,000 miles of wire from the usual commercial channels, for the exclusive use of the weather bureau. Two centers of collection and distribution, *viz.*, Chicago and New York, are a part of the new system. The largest factor in making the change was the very general use of automatic sending- and receiving-apparatus by the telegraph company in recent years whereby several channels of communication both ways are possible on a single wire.

The old system required hand operation, and traffic could flow but one way at a time.

ALFRED J. HENRY

WEATHER BUREAU,
WASHINGTON, D. C.

THE ABNORMAL SPECIFIC HEAT OF A RAREFIED GAS AT A LOW TEMPERATURE, AND THE COSMIC RADIATION

IN a paper that will appear in the May number of the *Journal of the Franklin Institute* it is shown thermodynamically that a gas at a very small molecular concentration, at which it is largely or altogether in the atomic state, near the absolute zero of temperature, has an abnormally large specific heat which may amount to thousands of calories per gram. This is due to three separate effects, each of which need not always occur. One of them is intimately connected with the remarkable result also obtained thermodynamically that the internal heat of evaporation of all substances is zero at the absolute zero of temperature. This result was obtained by means of the result deduced previously by the writer[1] that the adiabatic of zero entropy corresponds to zero absolute temperature. It was also obtained independently of considerations of the zero of entropy, thus incidentally furnishing welcome evidence from another direction of the truth of the foregoing result.

These abnormally large specific heats—they are likely to be specially large in the case of gaseous C, H_2, O_2 and N_2—are bound to be attended by great changes in the electronic configuration of the atoms with decrease of temperature, during which some of the electrons are likely to fall through very high potentials. This would give rise to an electro-magnetic radiation some of which might conceivably be of greater penetrating power than the γ radiation of radium. The cosmic radiation which appears to come from interstellar space might well be caused in this way. For no doubt this space contains various gases, especially the above, at an extremely low molecular concentration, whose temperature is near the absolute zero and still decreasing.

Since the air in the upper region of the atmosphere is at a low concentration and temperature, it is not improbable that a large part of the cosmic radiation proceeds from this region. If that is so the radiation arriving in a horizontal direction would be larger for a given solid angle than that in a vertical direction, a deduction which could be tested experimentally.

R. D. KLEEMAN

SCHENECTADY, N. Y.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

MACROSCOPICAL DETECTION OF THE MEDULLATED WOOL FIBER

The medullated wool fiber is considered a serious defect in the fleece. In the United States little if any attention has been given the problem of its elimination, possibly because most of the woven fabrics manufactured for clothing purposes in this country

[1] *J. Phys. Chem.*, 31, 940, 1927.

are made from the finer grades of wool, among which the medullated fiber does not so frequently occur. Among British wool manufacturers, however, the medullated fiber is looked upon as a menace to the prestige of British woven fabrics. It is thought to be responsible for harsh, wiry fleeces which do not work up well in the manufacturing processes. The medullated fiber is also criticised for lack of tensile strength and elasticity, and by some is accused of being responsible for uneven dyeing of certain goods.

Medullated fibers may be found among most of the improved breeds of sheep, including the Merino, but it is found in greatest quantity among the long-wool breeds, such as the Lincoln, Leicester, Cotswold and Romney. Sharp criticism of some New Zealand crossbred wools has recently been made by certain leading figures in the British textile trade, who point to the very great desirability of eliminating those "strong" or "hairy" fibers from the fleece. Obviously such elimination must be made by the breeder, if it is to be accomplished at all.

The presence of the medullated fiber can not be accurately detected by simple optical examination of the fleece, although the medulla is easily seen under the low power of the microscope when the fiber is prepared in a balsam mount. The literature on the subject contains no references to macroscopic detection.

A problem recently undertaken by the writer, involving the isolation of several thousand medullated fibers, led to the discovery of a method of detecting medullated wool fibers without the aid of a microscope. The method is simple and its use by breeders as well as by investigators seems warranted.

A rectangular piece of glass, of a size somewhat shorter in one dimension than the length of the fibers to be tested, is placed horizontally over a dull black or dark blue background. A small quantity of glycerin is then poured on the glass. The glycerin will have a tendency to spread over the glass and thus gradually become too shallow in depth to permit proper immersion of the fiber. This difficulty may be overcome by making on the glass a wall of paraffin in the shape of a parenthesis almost joined at the top and bottom. The fibers are cleaned in benzene to remove the excess of natural oil and dirt, and then are immersed one at a time in the shallow lake of glycerin. The ends of the fiber are held in the fingers and the two openings in the wall of paraffin permit the fiber to be held completely submerged and almost in contact with the glass.

The operation is carried on in natural light subdued to a point where reading would be difficult. The writer has found it convenient to work close to a window and to regulate the light by manipulation of a piece of very thick felt used in place of the ordinary window blind.

If the light has been properly regulated, a medullated fiber subjected to the treatment described can be seen as a faint white line across the glass, while non-medullated fibers can not be seen at all.

Tests of the efficacy of the method were carried out by examining under the microscope many fibers, both medullated and non-medullated, separated by use of the glycerin. These tests showed no errors in isolating medullated fibers, although a few which contained only traces of medullae were classed as non-medullated. The method is applicable to the examination of wool from any of the long-wool breeds, and with practice might be applied to finer fibers.

Tests with liquids other than glycerin, having a high refractive index, suggest that the index of refraction may be responsible for the phenomenon. Cottonseed oil, aniline, balsam, and other substances give fairly satisfactory results, while with water the detection is impossible.

J. F. WILSON

COLLEGE OF AGRICULTURE,
UNIVERSITY OF CALIFORNIA

A PERFUSION FLUID FOR ELASMOBRANCHS

THE use of diluted sea-water as a perfusion fluid for vertebrate tissues has been attended in the past with only partial success. Failure in the case of elasmobranch hearts, at least, was considered by Mines[1] to be due to the excessive magnesium content. The ratio of Mg to the other metals is about five times as great in sea-water as in elasmobranch serum, and about fifteen times as great as in the sera of land vertebrates.[2] Since the relative proportions of Na, K and Ca in sea-water are very similar to those found in vertebrate tissues generally, it seemed that the Mg might be the only disturbing factor.

It has been found possible to precipitate most of the Mg and relatively little of the Ca from sea-water by the addition of NaOH. To each liter of sea-water is added 12 cc of a 10 normal solution of NaOH, and the mixture is allowed to stand overnight in a stoppered flask. The flocculent precipitate settles in a compact mass at the bottom of the flask, and the supernatant liquid may be decanted easily through a filter. If the precipitate is not allowed to settle completely, filtration is unduly slow. The filtrate, after neutralization to pH 8 with a few drops of concen-

[1] Mines, G. R., "On the Relation to Electrolytes of the Hearts of Different Species of Animals," I—Elasmobranchs and Pecten, *Jour. Phys.*, 1912, 43, 467.

[2] Macallum, A. B., "The Paleochemistry of the Body Tissues and Fluids," *Phys. Rev.*, 1926, 6, 316.