cilities of the laboratory of the American Medical Association in Chicago. On the basis of data obtained through this laboratory, the College of American Pathologists will certify whether commercially produced standards which have been submitted comply with the specifications established by the NAS–NRC. All users are urged to insist that the cyanmethemoglobin standards they purchase commercially carry the certification label of the College (*5*).

Detailed instructions for the preparation of the standards have been published by Crosby (*6*). Producers of the standard or instrument manufacturers may obtain technical details on the adaptation to and use of the standard in the various hemoglobinometers by writing to the Division of Medical Sciences of the National Research Council.

Final Recommendations

The final recommendations of the National Research Council Ad Hoc Panel on the Establishment of a Hemoglobin Standard are as follows:

1) That cyanmethemoglobin be adopted as a standard in clinical hemoglobinometry.

2) That the standard be characterized spectrophotometrically on the basis that the extinction coefficient of 1 milligram atom of iron ($c = 1$ mg atom of iron per liter, $d = 1$ cm) in the form of cyanmethemoglobin at a wavelength of 540 mμ is 11.5.

3) That 0.338 percent (weight per weight) be accepted as the iron content of hemoglobin (molecular weight of 16,-$5\overline{20}$ per gram atom of iron) in accordance with the recent recommendation of the Protein Commission of the International Union of Pure and Applied Chemistry, and that a factor of $1{,}65\overline{2}$ be used in calculating hemoglobin in milligrams per 100 milliliters from millimoles per liter.

4) That the standard be distributed as a single concentration of not less than 55 mg of cyanmethemoglobin per 100 milliliters.

5) That solutions be distributed in brown glass containers and in sterile condition.

6) That, for the present, solutions be used as standards for a period not to exceed nine months from the time of preparation. This dating period is based upon the results of the National Research Council field trial. As experience accumulates with commercially prepared samples, an extension of the dating period may well be found to be justifiable.

7) That the standard be prepared from either crystalline hemoglobin or washed erythrocytes.

8) That commercial producers of the standards submit representative specimens from each lot to the College of American Pathologists, Prudential Plaza, Chicago 1, Illinois, for certification (i) that the concentration of cyanmethemoglobin is within ± 2 percent of the value stated on the label; (ii) that the solution is substantially optically clear; and (iii) that it is microbiologically sterile (*7*).

References and Notes

1. D. L. Drabkin and J. H. Austin, *J. Biol. Chem.* 112, 51 (1935); 98, 719 (1932).
2. W. H. Crosby, Jr., J. I. Munn, F. W. Furth, *U.S. Armed Forces Med. J.* 5, 693 (1954).
3. Proteins are not generally regarded as being highly stable in dilute solution, even if sterile. In spite of the experience of the U.S. Army, the panel hesitated to adopt a standard to which theoretical objection might be taken and explored other more stable materials. These included colored glasses and solutions of pigments so prepared as to approximate the absorption by cyanmethemoglobin of the spectral transmission of the filters, prisms, or gratings employed in photometers and spectrophotometers. These alternatives were rejected because (i) no suitable mixture of pigments suggested itself, (ii) it would be necessary to provide a series of glass standards to match the sizes and shapes of commonly used cuvettes, and (iii) for some instruments the glasses would also have to match the lens effect of the round cuvettes and their contents.
4. R. K. Cannan, *Am. J. Clin. Pathol.* 25, 376 (1955); *Am. J. Med. Technol.* 21, 150 (1955); *Blood* 10, 562 (1955); *Can. J. Med. Technol.* 17, 79 (1955); *Can. Med. Assoc. J.* 72, 455 (1955); *Can. Serv. Med. J.* 11, 115 (1955); *Clin. Chem.* 1, 151 (1955); *J. Lab. Clin. Med.* 46, 135 (1955); *Science* 122, 59 (1955).
5. In Canada discussions are now taking place in order to make one national laboratory responsible for the production and certification of the standard solutions.
6. W. H. Crosby, Jr., and D. N. Houchin, *Preparing Standard Solutions of Cyanmethemoglobin. WRAIR-77-57* (Walter Reed Army Institute of Research, Walter Reed Army Medical Center, Washington, D.C., 1957); *Blood* 12, 1132 (1957).

7. This work was supported by a grant from the National Heart Institute, National Institutes of Health, Contract No. H-2145.

News of Science

Research Based on Sputniks I and II Reported by Soviets

On 19 May the Soviet Embassy in Washington released an article on "Soviet artificial earth satellites" that presents in popular form some of the results of the experiments that Russian scientists are conducting in connection with the first two sputniks. The article, which is based on material published in *Pravda* on 27 April, states that fuller accounts of these results will soon appear "as scientific papers in various journals." Following are excerpts from the article.

"*Radio and optical observations of the sputniks.* Since an analysis of the changes in a sputnik's orbit as regards time makes it possible to estimate the density of the upper layers of the atmosphere, studies of the movements of sputniks are of great significance. The elements of a sputnik's orbit can be determined by tracking it by radiotechnical and optical methods.

"The radiotechnical methods included radio direction-finding and observations of the Doppler effect during the reception of radio signals from the sputniks. The Doppler effect is a result of the fact that the frequency of signals received increases as the object on which the radio transmitter is installed draws nearer to the receiving point. The changes in the frequency depend on the speed at which the object draws nearer or moves away. In the case of a sputnik the speed at which it draws nearer to, or moves away from, the receiving station on the ground is so great that the Doppler effect can not only be observed on an ordinary radio set, but can also be used for registering the moment the sputnik passes at the distance closest from the point of observation and also for measuring the distance to the sputnik and its velocity.

"During radio observations of the signals of Sputniks I and II, the frequencies of the signals received were measured by special radio equipment, including a recording chronograph.

"To obtain greater accuracy of measurement observations were conducted of signals at frequencies of 40 megacycles per second, which are less subject to the influence of the ionosphere. The power

of the transmitters ensured the definite reception of the signals within the entire zone of direct visibility. Six or seven passages of the sputnik over the ground stations could be observed consecutively during the course of 24 hours.

"To analyze the radio signals received, a method was worked out making it possible to determine with a precision of 0.1–0.2 seconds the moment at which the sputnik passes at the shortest distance from the observation point.

"The observations have confirmed that the Doppler effect can successfully be employed for determining the parameters of the sputnik's orbit. Simplicity and dependability of the equipment are distinctive features of this method. By raising the frequency of the transmitter installed on a sputnik and by automatic registration of the frequencies the errors of this method can be substantially reduced.

"The most simple method of optically tracking the sputniks was by registering the moment of their passage over the observation point.

"For a more precise determination of the bearings, special methods were employed; modernized aerial cameras were used for obtaining photographs of the track of the sputnik. The time during the filming was marked by several consecutive openings and closings of the shutter, and the timing registered by a photoelectric method. In this way a distinct track of the sputnik was visible on the photograph. A high degree of precision was obtained when using such cameras.

"A method of photography with highly-sensitive equipment has been worked out in tracking the artificial satellites. Very promising among these are electronic-optical transformers. The new method makes it possible to track the sputniks without the use of large optical systems, greatly simplifying the equipment necessary for observation.

"*Determination of the density of the atmosphere.* . . . The density of the atmosphere declines sharply as the distance from the earth's surface increases. That is why the force of resistance is unequal at different sections of an elliptical orbit. With a sufficiently elongated orbit the force of resistance in the perigee is much greater than in the apogee. Hence, the main deceleration takes place in the area of the perigee. Such a nature of varying deceleration results in the height of the apogee declining much faster than that of the perigee. A sputnik's elongated orbit changes so that its shape gradually becomes more of a circle.

"After the launching of the first sputniks optical observations and radio tracking made it possible to trace the evolution of their orbits. Since the action of the atmosphere on the sputnik on separate sections of its orbit is very small, scientists so far have not succeeded in measuring local deceleration. All data of the orbits immediately after the launching of the sputniks and also the changes in the periods from revolution to revolution throughout their life were measured on the basis of the observations of the first Soviet earth satellites with a precision sufficient for definitely determining the density of the atmosphere.

"The speed of change in the period of revolution greatly depends both on the density of the atmosphere in the perigee area and also on the speed with which the density declines as the altitude increases. The speed in the drop of the density is characterized by a parameter called the "height of uniform atmosphere," which is directly proportional to the temperature of the atmosphere and inversely proportional to its molecular weight.

"On the basis of a theoretical analysis of the results of the observations scientists succeeded in definitely determining the value of the product of the density of the atmosphere and the square root of the 'height of the uniform atmosphere' at altitudes of the perigees of the first sputniks (225–228 kilometers). The values of the density were calculated for definite theories regarding the value of the 'height of a uniform atmosphere.' The obtained value of density proved to be five to ten times greater than the values of density at these altitudes indicated in a number of models of the atmosphere built on the basis of rocket measurements prior to the launching of the sputniks. It should be noted that determination of the density by a study of the purely mechanical action of the atmosphere on the sputnik is quite exact.

"The atmosphere is not the same over various areas of the earth's surface. At the same altitudes the density and temperature change, depending on the latitude and time of day, which in turn is related to the unequal heating of the upper atmosphere by ultraviolet, x-ray and minute-particle radiations of the sun.

"As a result of the fact that the gravitational field of the earth differs from the central one, the orbits of the sputniks changed their position in space. Thus, for the first Soviet sputniks the angular distance of the perigee from the midday meridian changed approximately by 4 degrees and the latitude of the perigee changed by 0.35 degrees in 24 hours.

"Inasmuch as the main action of the atmosphere occurs in the perigee area of the orbit, the change of its position leads to a change in the value of deceleration. This makes it possible to estimate the value of the changes in the state of the atmosphere depending on the latitude and time of day.

"Calculations to determine the density of the atmosphere, taking into account the changes in the location of the perigee of the orbit, were made on the basis of observations of the first sputniks. The calculations showed that the product of the density and the square root of the 'height of uniform atmosphere' increases as the orbit passes from the night side of the atmosphere to the day side and reaches its maximum at noon. An analysis of deceleration also revealed a decline of this value during the passage from the more northerly regions into those of the equator. Mention should also be made of the fact that there is good coincidence in the values of densities calculated on the basis of observations of Sputniks I and II and the carrier-rocket of Sputnik I.

"The data obtained provide grounds for the conclusion that the temperature of the atmosphere at altitudes around 225 kilometers is higher than was formerly supposed on the basis of theoretical considerations. The discovery of higher temperatures of the atmosphere confronts geophysicists with the problem of the powerful sources of energy which heat the atmosphere. The known ultraviolet and x-ray radiation of the sun is hardly sufficient for that. At present only various hypotheses can be advanced. It may be assumed, for example, that the upper atmosphere in the Arctic regions is intensively heated by solar radiation of minute particles. It is possible that in general the entire upper atmosphere is additionally heated either by infrasound waves coming from the troposphere or by electric currents arising in the electrically-conductive ionized air as a result of its movement in the earth's magnetic field. . . .

"*Results of ionosphere exploration.* . . . Observations of the propagation of radio waves of various frequencies emitted by the sputniks at different altitudes are a new means of exploring the outer ionosphere.

"In receiving radio signals from the first sputniks at a frequency of 40 megacycles their 'radio dusk' and 'radio dawn' were fully observed in a number of cases and their respective time was recorded. In contrast to the optical dawn or dusk of a sputnik, which are characterized by the fact that at this moment the beam of light from the sputnik to the observer comes in a straight line, the radio beam at 'radio dawn' or 'radio dusk' is deflected in the ionosphere.

"Because of this, 'radio dusk' occurs later than optical dusk and conversely, 'radio dawn' precedes optical dawn. The difference in time between optical dawn and 'radio dawn' (or optical dusk and 'radio dusk') makes it possible to determine the magnitude of the deflection of the radio beam. Since the deflection of the radio beam in the ionosphere depends on the change in electron concen-

tration with altitude, it is possible, by assuming a certain law of the change of electron concentration, to calculate theoretically its magnitude at different altitudes. In doing so the influence of the lower strata of the ionosphere can be estimated on the basis of direct measurements carried out by a network of ground stations.

"The data obtained from observation of the radio signals from the first sputniks make it possible to consider that electron concentration in the outer ionosphere (above the chief maximum) decreases with the rise of altitude 5 to 6 times slower than it increases below the maximum. Thus, from an altitude of 100 kilometers to an altitude of 300 kilometers the electron concentration mounted during the period of observation (in October) approximately tenfold, and from an altitude of 300 kilometers to 500 kilometers it dropped by half.

"It should be noted that similar changes in electron concentration with the rise of altitude were also registered in launching a Soviet high-altitude rocket, which was reported in *Pravda*. In this experiment electron concentration at a height of 473 kilometers was of the order of 1,000,000 electrons in a cubic centimeter.

"*Study of cosmic rays.* For studying cosmic radiation Sputnik II was equipped with two instruments for registering the number of particles of this radiation. Circling the earth, the sputnik traveled at different distances from its surface. That is why measurements of the cosmic rays on the sputnik made it possible to ascertain the dependence of the number of particles on altitude. An analysis of the material obtained has revealed that the intensity of cosmic radiation increases by approximately 40 per cent from the minimal height of the orbit (225 kilometers) to an altitude of 700 kilometers. This increase is due primarily to the fact that the screening effect of the earth diminishes as altitude increases, and the cosmic rays are able to reach the instrument from a great many directions.

"The earth's magnetic field also creates an obstacle to cosmic radiation reaching the earth. Deviation of the particles of cosmic beams in the earth's magnetic field results in the fact that only particles whose energy exceeds a certain value can reach every point on the earth's surface in a definite direction. Naturally, the farther away we go from the earth, the weaker the magnetic field becomes, and the smaller is its effect upon the cosmic rays. Calculations show that the cosmic ray intensity increasing with altitude as measured in the flight of the sputnik can be explained by the above-stated reasons.

"A study of cosmic rays through instruments installed in a sputnik may also reveal the dependence of the intensity of cosmic rays on latitude and longitude. This makes it possible to obtain new information about the earth's magnetic field. Measurements of the magnetic field on the surface of the earth give an idea about the character of terrestrial magnetism and allow to foretell what the magnetic field should be at great distances from the earth. Proceeding from this it is possible to calculate the expected distribution of the intensity of cosmic rays over the earth's surface. Specifically, it is possible to indicate the lines of the constant intensity of cosmic rays (isocosm). Measurements of cosmic rays made during the flight of the sputnik have shown that the lines of constant intensity obtained experimentally and calculated theoretically differ substantially. This result is in good agreement with the conclusion of the American physicist, Simpson, who organized a large series of flights of high-altitude aircraft over the equator. They showed that the equator determined by means of cosmic rays does not coincide with the geomagnetic equator.

"Consequently, there is a considerable divergence between the characteristics of the earth's magnetic field obtained by means of cosmic rays, on the one hand, and by measuring the magnetic field on the surface of the earth, on the other. These divergences are due to the fact that the trajectories of cosmic rays are determined by the magnetic field at very high altitudes, while direct measurements characterize the magnetic field near the surface of the earth. Cosmic rays make it possible to 'sound' the earth's magnetic field at great distances from the earth, permitting a new approach to the study of the earth's magnetic field and the system of electric currents in the upper atmosphere.

"Observation of cosmic rays with the aid of sputniks have made it possible also to register variations in the intensity of this radiation. These variations are, obviously, connected with the condition of the interplanetary environment near the earth. One instance of a sharp increase (by 50 per cent) in the number of particles of cosmic radiation was registered. At that time, however, ground stations did not detect any essential increase in the intensity of cosmic radiation, and this event is now being studied in detail. It is possible that it was caused by the sun's generation of particles of low-energy cosmic rays (which are strongly absorbed by the earth's atmosphere) or by the sputnik passing through streams of high-energy electrons (connected with the minute-particle radiation of the sun). . . .

"*Biological investigations.* . . . Of great interest is the behavior and condition of the test animal in the most difficult, from the biological viewpoint, stage of the sputnik's flight—in its launching and entry into orbit. On its ascent to the orbit the sputnik traveled at an accelerated pace, the acceleration exceeding many times that of gravitation on the surface of the earth, and the seeming weight of the animal increasing with the acceleration.

"During the ascent the animal [Laika] was in a position for the acceleration to act on it in the direction from the chest to the back, which pressed the animal to the floor of the chamber. This position of the animal was chosen because it is a most favorable one for the organism. Simultaneously with acceleration, the vibration and noise of the rocket's engine reacted on the animal during the ascent.

"The behavior and condition of the animal during the sputnik's ascent to the orbit was registered quite fully. The information obtained indicates that the animal withstood the increase in its seeming weight and continued to move its head and body freely only until a certain point of the acceleration. After that the animal was pressed to the floor of the chamber and no more or less noticeable movements were registered.

"A study of the data obtained from the sputnik showed that immediately after the launching, the frequency of the heart contractions approximately trebled as compared with the initial frequency. The electrocardiograms have not revealed any morbid symptoms. They showed a typical picture of quickened heart-beat, the so-called sinus tachycardia. Later on when the effect of the acceleration not only continued but mounted, the heart-beat frequency diminished.

"One can easily imagine that as the seeming weight of the animal increased, the respiratory movements of its thorax became difficult, breathing became more shallow and frequent. Indeed, telemetric recordings show that in the sputnik's ascent to its obrit, the animal breathed three to four times as fast as it did at the beginning.

"There is reason to assume that the changes observed in the condition of the animal's physiological functions owe their origin to the sudden action on the organism of sufficiently strong external irritants: acceleration, noise and vibration, which began at the launching and continued on the ascent. An analysis of the data obtained and their comparison with the results of preceding laboratory experiments indicate that the animal withstood the flight quite well from the launching to the entry of the sputnik into orbit.

"After the sputnik got into orbit, the centrifugal force acting upon it balanced the earth's attraction, and a state of weightlessness set in. In this condition the animal's body ceased to press upon

the chamber's floor, and by contracting the muscles of its extremities it easily pushed itself off the floor. The recordings suggest that these movements were brief and rather smooth.

"As the animal's thorax was no longer pressed under the influence of its increased weight, the frequency of its breathing declined. After a very brief period of quickened heart-beat, the systole frequency continued to diminish, consistently approached its initial level. It took, however, about three times as long for the number of heart beats to reach the initial level as it did in laboratory experiments in which the animal was subjected to the same acceleration as when the sputnik was put into orbit.

"This is most probably connected with the fact that in the ground experiments the animal, after the acceleration ended, was in normal conditions, while in the sputnik the acceleration was replaced by a state of complete weightlessness.

"In this state the animal's nerves whereby it feels the position of its body in space were not sufficiently affected by the external irritants. This conditioned the change in the functional state of the nervous system regulating blood circulation and respiration and determined a certain extension of the time for the normalization of these functions after the acceleration effect ended.

"It is also possible that this phenomenon was somewhat intensified by the action of concomitant factors during the ascent—vibration and noise, which were greater than in the laboratory experiments.

"It should be noted that the change in the physiological functions, registered in the animal at the beginning of the sputnik's movement along its orbit, coincides basically with the results of previous investigations with high-altitude rockets.

"An analysis of an electrocardiogram recorded during the state of weightlessness revealed certain changes in the configuration of its elements and the duration of separate intervals. The observed changes were not of a pathological nature and were connected with the heightened functional activity during the period preceding the state of weightlessness. The electrocardiogram showed transient reflected nervous changes in the regulation of the heart's action. In the subsequent period the picture of the electrocardiogram grew increasingly closer to that characteristic of the animal's initial condition. In spite of the unusual state of weightlessness the animal's motions were moderate.

"The normalization of blood circulation and respiration during the period of weightlessness, *i.e.*, during the period of the sputnik's movement along its orbit, evidently indicates that this factor in itself did not cause any essential and stable changes in the state of the animal's physiological functions. Thus it may be said that the animal well endured not only the sputnik's ascent to the orbit but also the conditions of travel along the orbit.

"In ensuring the conditions necessary for the animal's vital activity in a prolonged flight in a sputnik, it is most important to provide a proper gas environment, the composition and pressure of which should not cause violations of the animal's physiological functions. This task could be accomplished only by the use of an hermetically sealed chamber in which normal atmospheric pressure with an oxygen content of 20 to 40 per cent and a carbon dioxide gas content of no more than one per cent was maintained by air regeneration.

"Special highly active chemical compounds which, absorbing water vapors and carbon dioxide, emitted oxygen were used as regenerating substances. These chemical compounds absorbed also such noxious gases formed in the process of the animal's vital activity as ammonia, for example. An analysis of the data obtained showed that oxygen was emitted in sufficient quantities. The fact that the pressure in the chamber did not drop shows that it was effectively sealed. . . ."

Center for Communication Sciences

A Center for Communication Sciences has been set up at Massachusetts Institute of Technology to conduct studies of the communication functions of the nervous system, of computers, and of organisms and machines in conjunction with each other.

The center will use the facilities of the Research Laboratory of Electronics, where there has been a concentration of interest in this field. The steering committee for the center is composed of Jerome B. Wiesner, director of the Research Laboratory of Electronics; Claude E. Shannon, one of the originators of the mathematical theory of communication; Gordon S. Brown, head of the department of electrical engineering; Robert M. Fano, a communications engineer specializing in information theory; Roman Jakobson, a linguist; and Walter A. Rosenblith, a biophysicist with a special interest in sensory communications.

The activities of the new center can be traced back to the Massachusetts Institute of Technology Radiation Laboratory, which, during World War II, was responsible for the development of radar. After the war, the Research Laboratory of Electronics was established to continue research work in related fields on a peacetime basis. Staff members of the laboratory have worked on a large number of problems, but increasing interest in the communication sciences has resulted in the participation of research-workers from fields not commonly associated with electrical engineering, such as psychology, physiology, and linguistics.

Among the questions to which the center would like to find the answers are the following: Can we describe in mathematical form the grammar of a natural language? Can we give a rational account of the way in which the brain processes information coming to it through the senses? What role does information play in human learning and decision-making? Are there laws which resemble the laws of physics in their generality and predictive power?

Scientific Secretaries for Atomic Energy Conference

An international team of 21 scientific secretaries from 13 countries has been appointed for the second United Nations International Conference on the Peaceful Uses of Atomic Energy, to be held in Geneva 1–13 September. All have arrived at U.N. Headquarters in New York. They will work there, and later in Geneva, on the subjects that will receive major attention at the conference: nuclear fission; fission reactor engineering; physics; biology and isotopes; and raw materials, mining, and chemistry.

The secretaries, whose appointments were announced last month by Sigvard Eklund, conference secretary-general, are: Renee Bovy (Belgium), Frank Bruce (United States), Terence E. F. Carr (United Kingdom), Thomas C. Church (Canada), Thomas Coor (United States), D. Harold Copp (Canada), Israel Dostrovsky (Israel), Aleksandr Nikitich Efimov (U.S.S.R.), Hiroshi Fukunaga (Japan), Claudio Garavaglia (Italy), Fred Hudswell (United Kingdom), David Okrent (United States), Ivan Dmitrievich Rozhansky (U.S.S.R.), Afaf A. Sabri (United Arab Republic), Carlos Sanchez del Rio (Spain), Cesar Sastre (Argentina), Gavriil Sergeevich Strelin (U.S.S.R.), Pierre Yves Tanguy (France), Ivan Ulehla (Czechoslovakia), William Brian Woollen (United Kingdom), and Valery Ziegler (France).

News Briefs

Revue de Géographie Physique et de Géologie Dynamique is again being published after suspension because of World War II. For information, communicate with Masson et Cie., éditeurs, Paris.

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Norman Hilberry, director of Argonne National Laboratory, is heading an atoms-for-peace survey mission to Latin America. This is the first major project