TABLE 2

EFFECT OF DNP ON THE OXIDATION OF VARIOUS SUBSTRATES BY RESTING *A. suboxydans* CELLS*

Amt substrate (μmoles)	DNP concentration	Time of oxidation (min)	O_2 uptake (μatoms)
40 Glycerol	—	400	147
40 "	10^{-4} *M*	400	43
20 DHA	—	320	61
20 "	10^{-4} *M*	320	7
90 Ethanol	—	120	170
90 "	10^{-4} *M*	120	179
40 Sorbitol	—	450	158
40 "	10^{-4} *M*	450	53

* The system contained 0.05 *M* phosphate, 0.01 *M* $MgCl_2$, 10^{-4} *M* DPN and 10 mg (dry wt) of room temperature-washed cells per Warburg flask. Total volume = 2.8 ml; pH = 6.0; temp. = 29° C; air in gas phase. The substrate was tipped into the main compartment containing DNP after 5 min preincubation. All values corrected for endogenous blanks.

which is generally regarded as a phosphate "uncoupling" agent (*17, 18*), might affect only the reactions beyond DHA from glycerol. Representative data, summarized in Table 2, show this to be true. The first atom of oxygen was rapidly consumed in glycerol oxidation either in the presence or absence of DNP. However, after 1 atom of oxygen had been used, the reaction virtually ceased in the flasks containing 10^{-4} *M* DNP. With DHA, almost no oxidation occurred in the presence of DNP. Likewise, in the oxidation of sorbitol, DNP affected only the oxidation steps beyond sorbose, so that 1 atom of oxygen was utilized per mole. Ethanol oxidation, on the other hand, was completely unaffected by DNP.

The growth of *A. suboxydans,* either in glycerol or sorbitol media, was unaffected by DNP even at concentrations of the inhibitor up to 4×10^{-4} *M*. The results of some preliminary experiments showed that the filtrate of the fermentation liquor from a medium containing 5% sorbitol and 0.5% yeast extract had higher reducing power in the presence of DNP than in its absence, indicating an increased yield of sorbose. The above observations raise the question whether some of the energy storage mechanisms in this organism may differ from those in higher animals or other bacteria, in which coenzyme-linked energy-rich phosphate is regularly generated. Further details of these studies will be reported later.

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Manuscript received August 7, 1951.

The Absorption of Human Skin between 430 and 1,010 mμ for Black-Body Radiation at Various Color Temperatures

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It is an accepted premise that if dark and light skins are irradiated by the same source radiating in the visible and near infrared part of the spectrum the dark skin will absorb more than will the light skin. As far as the author can ascertain nothing has been published concerning the quantitative relations for the absorptance of skins of various colors. This paper is written to show the expected relative absorption of tanned and untanned white and Negro skin for the radiation between 430 and 1,010 mμ emanating from sources radiating at various color temperatures.

It is known that for black-body radiation at color temperatures less than 8×10^{3}° K there is no attenuation due to the transport of radiation through the atmosphere. As the color temperature of a source increases, the transmission coefficient for air decreases until, at 25,000° K, the transmission coefficient is approximately 0.4. Since the temperature of the ball of fire (which is considered to be a good approximation to a black-body radiator) resulting from the explosion of a nominal atomic bomb falls to 8×10^{3}° K in approximately 20 μsec when the radius of the ball of fire is thought to be about 8 yards (*1*) (a distance at which thermal radiation has not yet begun to play an important part), attention is not given to atmospheric attenuation. Neither is attention given to the fact that the flux density of the radiation varies with distance, nor that the type of day (clear or hazy) has an effect on the amount of radiation reaching a given point. The concern here is with the comparison of the maximum expected absorption of tanned and untanned skin of the white and Negro races. Although the ordinate of the accompanying graph is expressed in units of energy, it should be kept in mind that this energy is for the maximum expected absorption at the surface of the radiator and that no attempt has been made to calculate the energy arriving at a particular distance, as some authors have done.

The average absorptance values were calculated from average reflectance values obtained from individual reflectance recordings of 113 subjects (71 white and 42 Negro). The reflectance curves were taken from three parts of the body: (*a*) a least-tanned spot (the inside of the right forearm midway between the wrist and the elbow), (*b*) a most-tanned spot (the outside of the left forearm midway between the wrist and the elbow), and (*c*) an average-tanned spot (the forehead over the left eye). The recordings were made on a G-E Recording Spectrophotometer operating on a range 431–1,000 mμ. The measurements were made in September in order to show as much difference as possible between the tanned and untanned skin areas.

If one considers what may happen to radiation falling on an object, it is apparent that the radiation may, generally speaking, be absorbed, reflected, or transmitted. Since 99% of the radiation which penetrates the skin is absorbed in the first 3 mm (*2*), and since the reflectance values are expressed in percentages, it can be assumed that 100 minus the reflectance, expressed as percentage, will give the percentage absorptance. This absorptance includes true absorption and scattering.

The absolute energy distribution for black-body radiators at various color temperatures from 2,000° K to 25,000° K (the range of temperature selected) for wavelengths from 440 to 1,000 mμ had to be determined. The energies from 440 to 720 mμ were calculated from Table 2B of *Misc. Pub. No. 56,* of the National Bureau of Standards (1925), at 20-mμ intervals. The energies from 700 to 1,000 mμ were calculated by use of the Planck formula

$$E = \frac{C_1 \lambda^{-5}}{e^{(C_2/\lambda T)} - 1},$$

where E = energy radiated in 1-mμ band width expressed in ergs/sec/cm^2; $C_1 = 3.703 \times 10^{23}$; λ = wavelength expressed in mμ; e = base of the natural logarithms; $C_2 = 1.435 \times 10^7$ (440–720 mμ); $C_2 = 1.433 \times 10^7$ (700–1,000 mμ); and T = absolute temperature of the radiator (°K). Since the values of C_2 in the two sets of calculations were slightly different, the energies at 700 mμ and 720 mμ were calculated by both methods. It was found that the two methods had a percentage difference of less than 0.1%, a difference less than the possible error in the individual reflectance curves, the allowable error of the G-E Spectrophotometer being 0.5%.

The procedure for arriving at the amount of radiation absorbed from a radiator at a particular color temperature was as follows: One of the six sets of absorption data and a particular color temperature were chosen. The absorption at 440 mμ was multiplied by the energy at 440 mμ, the absorption at 460 mμ was multiplied by the energy at 460 mμ, etc.; finally, the absorption at 1,000 mμ was multiplied by the energy at 1,000 mμ. These products are the ordinates of a curve of expected energy absorption vs wavelength. It was not felt necessary to plot this curve, since interest was not in the energy absorption at a particular wavelength but in total absorption. The increment of wavelength was 20 mμ throughout. Therefore, the area under the curve was taken as:

$$20 \times \text{Ordinate}_{440} + 20 \times \text{Ordinate}_{460} + \ldots + 20 \times \text{Ordinate}_{1,000}$$

or

$$\text{AREA} = 20(\text{Ordinate}_{440} + \text{Ordinate}_{460} + \ldots + \text{Ordinate}_{1,000})$$

This area represents the total expected energy absorption for a particular type of skin which is exposed to a black body radiating at a particular color temperature.

It can be shown that the average percentage difference in total expected absorption for white average-tanned and most-tanned skin averages less than 2%, showing a maximum difference of 4.4% at 2,000° K. It can also be shown that the average percentage difference for Negro average-tanned and most-tanned skin is less than 1%, again the maximum difference (2.3%) being at 2,000° K. These percentage differences were considered small enough so that concern, henceforth, was with the tanned (forehead over left eye) and untanned (inside right forearm) parts of the body. None of the results applies explicitly to the most-tanned part of the body.

The comparison of the expected absorptions for white and/or Negro skin for any of the areas meas-

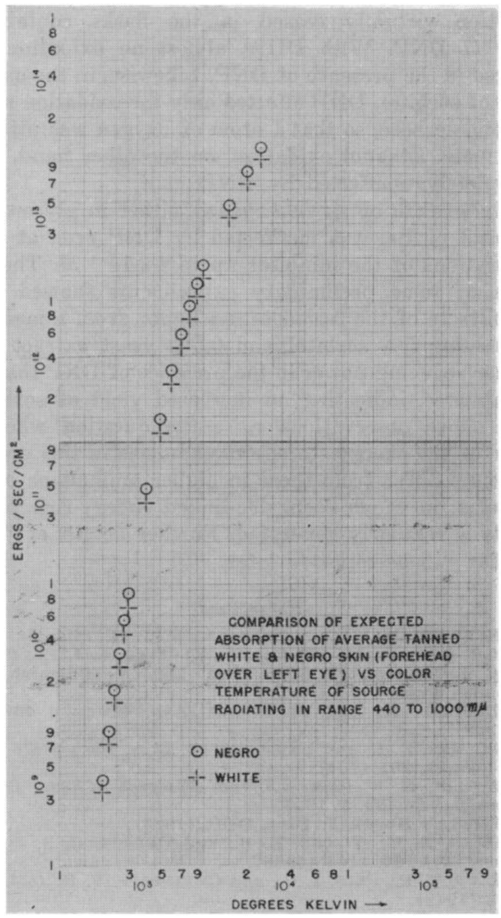

FIG. 1.

ured can be shown graphically. Fig. 1 shows the comparison of expected absorption for average-tanned Negro and average-tanned white skin. For example, at 4,000° K the total expected absorption for the average-tanned Negro skin is about 4.70×10^{11} ergs/sec/cm^2, and for the average-tanned white skin the total expected absorption is about 3.70×10^{11} ergs/sec/cm^2. Dividing the Negro value by the white value shows that we may expect approximately 27% more absorption for the tanned Negro than for the tanned white when they are both irradiated by a black body radiating at 4,000° K. Table 1 shows the ratio of expected absorptions for various skins being irradiated by radiators at various color temperatures.

TABLE 1

RATIO OF EXPECTED ABSORPTIONS OF AVERAGE TANNED AND UNTANNED WHITE AND NEGRO SKIN FOR VARIOUS COLOR TEMPERATURES

Color temperature	White forehead over left eye / White inside right forearm	Negro forehead over left eye / Negro inside right forearm	Negro inside right forearm / White inside right forearm	Negro forehead over left eye / White forehead over left eye	Negro forehead over left eye / White inside right forearm
2,000	1.15	1.10	1.27	1.22	1.39
2,200	1.15	1.09	1.29	1.23	1.41
2,400	1.15	1.09	1.31	1.24	1.43
2,600	1.15	1.09	1.32	1.25	1.44
2,800	1.15	1.09	1.34	1.26	1.45
3,000	1.15	1.09	1.34	1.27	1.46
4,000	1.15	1.08	1.37	1.27	1.47
5,000	1.16	1.07	1.37	1.27	1.47
6,000	1.16	1.07	1.36	1.25	1.46
7,000	1.16	1.06	1.36	1.25	1.45
8,000	1.16	1.06	1.36	1.24	1.44
9,000	1.16	1.06	1.36	1.24	1.44
10,000	1.16	1.06	1.35	1.24	1.43
15,000	1.16	1.05	1.34	1.22	1.41
20,000	1.16	1.05	1.34	1.22	1.41
25,000	1.15	1.05	1.34	1.22	1.40

Dividing the expected absorption of white tanned skin by the expected absorption of the white untanned skin showed that, for the color temperature range considered, the tanned skin would absorb 15–16% more energy than the untanned skin (Table 1). Applying the same procedure to the Negro showed the tanned skin would absorb an average of 7.2% more energy, varying from 10% more at 2,000° K to 5% more at 25,000° K. Comparing untanned Negro skin to untanned white skin, it was found that on the average the Negro would absorb 34% more energy than the white. This percentage increase was neither as constant nor as linear-appearing as the first two mentioned, starting at 27% at 2,000° K, increasing to 37% at 4,000° K, and then decreasing to 34% at 25,000° K. Comparing tanned Negro skin to tanned white skin, it was found that the Negro absorption would average 24% more than the white, varying from 22% at 2,000° K to 27% at 4,000° K, and then decreasing to 22% at 25,000° K. As the largest difference, it was found that the tanned Negro skin would average 44% more absorption than the untanned white skin, the variation going from 39% at 2,000° K, to 47% at 4,000° K, and back to 40% at 25,000° K.

TABLE 2*

EXPECTED RELATIVE ABSORPTIONS FOR AVERAGE UNTANNED AND TANNED WHITE AND NEGRO SKIN, TAKING RESPECTIVE ABSORPTIONS AT 2,000° K AS UNITY

Color temperature	White inside right forearm (Untanned)	White forehead over left eye (Tanned)	Negro inside right forearm (Untanned)	Negro forehead over left eye (Tanned)	Average
2,000	1.00	1.00	1.00	1.00	1.00
2,200	2.20	2.20	2.23	2.23	2.22
2,400	4.32	4.32	4.44	4.43	4.38
2,600	7.75	7.77	8.05	8.02	7.90
2,800	13.2	13.3	13.9	13.8	13.6
3,000	20.5	20.6	21.7	21.5	21.1
4,000	113.	114.	121.	119.	117.
5,000	346.	349.	372.	364.	358.
6,000	764.	770.	820.	798.	788.
7,000	1,380.	1,390.	1,480.	1,430.	1,420.
8,000	2,180.	2,200.	2,330.	2,260.	2,240.
9,000	3,160.	3,190.	3,370.	3,260.	3,240.
10,000	4,280.	4,320.	4,560.	4,390.	4,390.
15,000	11,500.	11,600.	12,100.	11,600.	11,700.
20,000	20,200.	20,300.	21,200.	20,400.	20,500.
25,000	29,600.	29,800.	31,100.	29,800.	30,100.

* The numbers in the table are quotients of expected energy absorption of skin being irradiated by various color temperature radiators divided by expected energy absorption of the same type skin being irradiated by a radiator at 2,000° K.

The increase of color temperature of the source necessary to produce a particular increase in absorption for white and Negro tanned and untanned skin was determined as follows: The expected absorption of each type of skin at each color temperature was divided by its expected absorption at 2,000° K. These values were then averaged, the over-all averages appearing as Column 6 in Table 2. It was found that the white averages varied from 0 to 3% below, and the Negro averages varied from 0 to 3% above, the over-all average. This slight difference is probably not significant from the standpoint of thermal radiation injury.

Taking the expected absorption for 2,000° K as unity, it was found that an increase of absorption by a factor of 10 could be expected for a radiator at 2,700° K, an increase of 10^2 for CT (color temperature) at 3,900° K, an increase of 10^3 for CT at 6,200° K, and an increase of 10^4 for CT at 14,000° K. It was noted, from the convexity of the graph in the direction of increase in energy, that the expected absorption increased more rapidly with an increase in CT in the region 2,000° K than it did in the region 25,000° K (*3*).

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Manuscript received August 8, 1951.

The Retention of a Discrimination

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One of the earliest and most persistent problems in the functional analysis of the behavior of living organisms has been that of the retention or loss ("forgetting") of a learned performance over a period of time. There are, of course, a number of experimental operations that may be used to reduce the probability of a given action: these include, e.g., withholding the reinforcement for the act, changing the stimulus conditions, reducing the drive, or reinforcing competing behavior (including that which prevents aversive stimulation following upon the original act). But a special problem is posed by the observation that a deterioration occurs in the subject's performance with the passage of time even when no experimental operation is performed. This has led to the concept that time itself may be the pertinent variable at a psychological level of analysis. However, since the very existence of the organism during the interval between the successive tests implies the operation of certain relevant variables, it seems unlikely that the independent effect of the passage of time, if any, can be isolated and measured. The most that can be said is that when appropriate techniques are employed a substantial retention of simple motor acts over long periods of time may be demonstrated (*1–7*). Such findings, however, have not yet been extended in any clear fashion to the retention of a discrimination (i.e., an appropriate relationship between the probability of the act and the stimuli which have marked the occasions when it will be reinforced). This is the purpose of the present study.

Six white rats were put on a daily feeding rhythm which maintained them at approximately 85% of their body weight under *ad lib* feeding. A bar or lever was inserted into the experimental cage (*8*), and each depression of this bar was followed by the delivery of a 1/15-g pellet composed mainly of Purina laboratory chow. When the animals were conditioned, the discrimination training was begun by making the further receipt of food contingent upon the presence or absence of cage illumination from above (4.5 ft-c). Light and darkness were alternated in 5-min phases throughout daily sessions of 100 min each. Certain of the pressings in the light (S^D) were reinforced with food at irregular intervals (mean of 2 min); none of the pressings in the darkness (S^Δ) was reinforced. By the end of 16 such training sessions, 85–90% of all responses occurred during the light phase of the cycle. Seven further test sessions were then conducted that were identical in procedure save for a systematic manipulation of the hunger drive. The results of these tests, plus further details of apparatus and procedure, may be found in a separate paper (*9*).

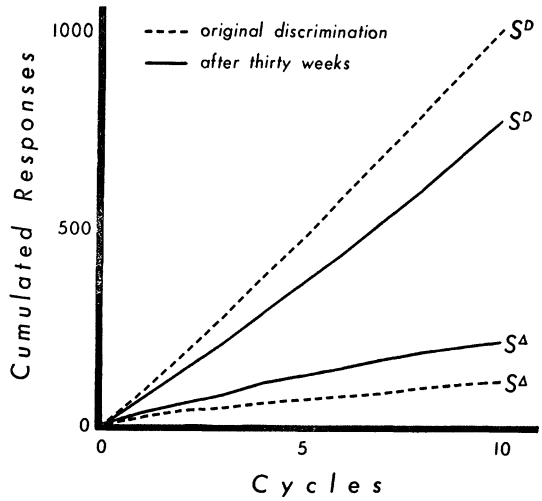

Fig. 1. The mean number of bar-pressings by 5 rats cumulated at the end of each 10-min cycle during a 100-min test session at the end of training and again 30 weeks later. The response was intermittently reinforced with food in the S^D (light phase of the cycle) but never in S^Δ (darkness).

In order to measure the retention of the discrimination over a period of time, all animals were brought back to 85% of normal body weight for an initial test session. One subject died during the ensuing period, but 30 weeks later the remaining 5 animals were tested a second time. To determine whether the rate of responding from cycle to cycle within either test period remained proportional to the total responding for the session, group means were calculated for each cycle. In both cases the rate of responding in S^D shows a slight increase (slope = 2.6 and 2.5 responses/cycle, respectively, by the method of least squares) and the rate in S^Δ a slight decline (−1.0 and −1.7) throughout the session. As may be seen in Fig. 1, however, where these means are cumulated for successive cycles, the shapes of the corresponding curves within either test session are approximately the same. It seems legitimate, therefore, to employ the totals for either session as measures of the animals' functioning before and after the retention interval.

Individual totals for each of the 5 animals are presented in Table 1. The typical effect of the passage of time is an increase in S^Δ responding (4 of 5 animals) and a decrease in S^D responding (all 5). The mean percentage of responding occurring in S^D drops from 89.9 on the first session to 80.3 on the second, a loss of 9.6 points. In view of the small number of subjects,

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