Success of such a program, however, is dependent on the willingness (i) of the scientist to communicate, and (ii) of the public relations man to adjust his promotive characteristics to the disciplines of science.

Effective public relations *is not* so much a matter of headline grabbing and photographic tricks as it is of advancing the welfare of a cause by identifying its objectives with the public good and telling its story to people, with the sole intent of ultimately bringing its benefits to more people.

By employing the techniques of modern communications and espousing the aims of good public relations, science can and will bring its benefits to more people.

MILTON MURRAY

College of Medical Evangelists
Loma Linda and *Los Angeles, California*

Received April 7, 1954.

Thermal Precipitation Analyzed

I read with considerable interest the communication of B. W. Wright (*1*).

It would be difficult for us to measure directly the amount of heat transferred to the cold plate, since there is very little change in the temperature of our cooling water. Also, owing to losses to the surroundings, the amount of heat utilized is only a fraction of the power input. However, we can arrive at a figure for the required power input from a conductivity calculation. If suitable values are inserted into the conductivity equation, $Q = kA\Delta t/x$, where Q is the amount of heat transferred, k is the mean thermal conductivity of air, A is the area of the heated surface and $\Delta t/x$ is the temperature gradient, the value obtained for the power input of a typical run was 6.1 w. The total electric power input was 78 w. This run was with MgO smoke at 600 ml/min, a spacing of 0.010 in., and gave a deposit 3.9 cm in diameter.

I have derived an equation that describes the operation of this type of precipitator by utilizing the equation for the thermal force given by Epstein (*2*) and confirmed by Saxton and Ranz (*3*). Making a force balance on a particle that is being acted on by a viscous drag force, a gravitational force, and a thermal force, I arrive at the equation for the case of the precipitators described by Kethley *et al.* (*4*) and Wright,

$$\frac{q}{\pi z(z+2r)} = \frac{D_p(\rho_p - \rho)g}{18\mu} + \frac{3}{2}\left(\frac{R\mu}{MP}\right)\left(\frac{k}{2k+k_p}\right)\frac{\Delta t}{x}, \quad (1)$$

where q = volume rate of flow, z = length of deposit (= radius of deposit − radius of inlet opening), r = radius of inlet opening, D_p = diameter of aerosol particle, ρ_p = density of aerosol material, ρ = density of gas, g = gravitational acceleration, μ = viscosity of gas, k = thermal conductivity of gas, P = gas pressure, k_p = thermal conductivity of aerosol particle, R = gas constant, $\Delta t/x$ = thermal gradient between hot plate and cold plate, M = molecular weight of gas.

It should be noted that Eq. (1) is of the form

$$V = A + B\Delta t/x,$$

where V is a function of the precipitator geometry and aerosol flow rate, A represents the component of the particle motion attributable to gravity, and $B\Delta t/x$ is the component due to thermal force. In practice, we plot the left-hand member of the equation against the temperature gradient and get a series of points that approximate a straight line for aerosols of the same material and size distribution.

The reason good correlation of performance with power input has been obtained by Wright and others is that, to a large extent, the power input is a function of the thermal gradient.

Examination of the equation also indicates that the performance of a thermal precipitator depends on the absolute temperature of the system only to the extent that the thermal conductivities of the gas and aerosol material and the gas viscosity depend on the absolute temperature.

MENDEL T. GORDON

Engineering Experiment Station
Georgia Institute of Technology, Atlanta

References

1. B. W. Wright, *Science* **118**, 195 (1953).
2. P. Epstein, *Z. Physik* **54**, 537 (1929).
3. R. L. Saxton and W. E. Ranz, *J. Appl. Phys.* **23**, 917 (1952).
4. T. W. Kethley, M. T. Gordon, and C. Orr, Jr., *Science* **116**, 368 (1952).

Received April 2, 1954.

The Fungistatic Action of Squalene on Certain Dermatophytes *in Vitro**

Squalene is an unsaturated triterpenoid hydrocarbon that was originally isolated from the liver oil of the shark (*1*). Among its other occurrences, it was found to be present in the fat from ovarian dermoid cysts (*2*). It has also been found in normal human sebum (*3, 4*).

An investigation was undertaken in order to learn whether squalene might exert a protective action on skin. This could come about because squalene, which has the consistency and appearance of mineral oil when pure, rapidly takes up oxygen on exposure to air and forms a yellow viscous oil with a high peroxide content.

It was found that undiluted squalene (*5*) on the surface of Sabourand's agar prevented multiplication of *Microsporum mentagrophytes*, *M. audouini* (*6*), and *M. tonsurans* (*6*). Undiluted mineral oil under the same conditions did not inhibit growth. In the case of *M. gypseum* (*6*), squalene inhibited growth in some instances, partially in others, and at times not at all. Squalene caused no inhibition of the multiplication of *Aspergillus terreus*.

Some evidence suggests that squalene exposed to air for a time prior to use may be more effective in inhibiting growth than pure squalene. These observations suggest that squalene may be a protective agent on the skin. It is hoped that this communication will stimulate clinical investigation of this material.

* This project is supported by grant C-2012 of the National Cancer Institute, U.S. Public Health Service.

The authors are grateful to Mrs. E. B. Goolden for assistance in this project.

HARRY SOBEL
JESSIE MARMORSTON
HILDA ARZANGOOLIAN

Department of Biochemistry, Division of Laboratories; and *Institute for Medical Research, Cedars of Lebanon Hospital*; and *University of Southern California School of Medicine, Los Angeles*

References and Notes

1. M. Tsyjimoto, *Ind. Eng. Chem.* **8**, 889 (1916).
2. A. Dimter, *Z. physiol. Chem.* **270**, 247 (1941).
3. H. Sobel, *J. Invest. Dermatol.* **13**, 333 (1949).
4. R. M. B. MacKenna, V. R. Wheatley, and A. Wormall, *J. Invest. Dermatol.* **15**, 33 (1950).
5. Obtained from the Distillation Products, Inc., and purified by passing through alumina.
6. Obtained from the American Type Culture Collection.

Received March 17, 1954.

The Tetrazolium Reaction in Yeast

In studies dealing with phytotoxic effects of hydrocarbons, the use of yeast as test material was suggested by Collander and Äyräpää (*1*), who outlined a simple permeability experiment suitable for laboratory or for class demonstration. Neutral red was employed as a penetrating indicator.

Under the appropriate conditions, yeast absorbs the vital dye 2,3,5-triphenyltetrazolium chloride (TTC) and reduces it intracellularly to a red formazan (*2*, *3*). Dead cells, following exposure to lethal concentrations of benzene, do not react. A simple demonstration of two factors related to vital TTC reduction is the following.

A quantity of wet compressed yeast cake is mixed with an equal weight of water, and 1 ml of the suspension is added to 100 ml each of the following four solutions. All contain 0.1 percent TTC and 0.01*M* phosphate buffer *p*H 7.6. In addition, the following are present: in 2, glucose 1 percent; in 3, benzene 0.1 percent by volume; in 4, glucose 1 percent and benzene 0.1 percent. The stoppered bottles are agitated from time to time.

Within about 5 min following addition of yeast, bottle 4 should be perceptibly pink, followed by 2, 3, and 1. In about 40 min, bottles 1–4 should show an increasing redness. Longer times will intensify the color but will decrease the differences. Strong illumination is undesirable, since it tends to reduce the dye photochemically outside the cells. A control bottle containing solution 4 but no yeast remains colorless.

The following interpretation of these results is suggested. Tetrazolium normally penetrates the yeast cell slowly. Benzene, through its lipid solvent action, increases permeability to the dye. This explanation finds support in the work of Hurst (*4*). Water that is 95-percent saturated with benzene is lethal to yeast in 8 hr at 25°C, but the approximately half-saturated solution used in these tests does not seem to be injurious. Sugar provides substrate for respiratory enzymes involved in the reduction of TTC. Yeast diaphorase is believed important in this regard (*5*).

That the cells were alive in all treatments after 1 hr was shown microscopically by a characteristic neutral red accumulation, by plasmolytic response to strongly hypertonic solutions, and by colony formation on grape-juice agar.

The question arises whether the action of benzene might not be one of increasing respiration. To obtain information on this point, oxygen uptake of yeast was determined by Warburg's direct method. At eight different concentrations of benzene, increasing from 7 to 83 percent of saturation, there was no significant effect on oxygen consumption within 1 hr. In saturated solution, however, the rate was 22 percent of the control. Further tests utilizing Dixon-Keilen flasks provided a measure of both O_2 and CO_2 exchange. A similar inhibition in saturated benzene solution was obtained, depressing CO_2 production more than O_2 absorption.

The foregoing considerations favor the interpretation that the benzene effect is an enhanced permeability toward TTC. Whether benzene increases permeability toward sugar at the same time, or whether sugar itself increases permeability, cannot be decided on the basis of these tests. The action of benzene is nonspecific, and the same effect is produced by other relative nonpolar substances, for example, ethyl ether, xylene, and 1-octanol.

In addition to laboratory use, these observations may have a bearing on the use of the tetrazolium reaction as a criterion of vitality. It has been noted that for certain cells (*6*) failure of TTC to penetrate constitutes a limitation.

H. B. CURRIER
B. E. DAY

Department of Botany
University of California, Davis; and
Department of Plant Physiology
University of California, Riverside

References

1. R. Collander and T. Äyräpää, *Acta Physiol. Scand.* **14**, 171 (1947).
2. R. Kuhn and D. Jerchel, *Ber. deut. chem. Ges.* **74B**, 949 (1941).
3. F. W. Gunz, *Nature* **163**, 98 (1949).
4. H. Hurst, *J. Exptl. Biol.* **29**, 30 (1952).
5. A. F. Brodie and J. S. Gots, *Science* **114**, 40 (1953).
6. R. J. Stein and H. W. Gerarde, *Science* **111**, 691 (1950).

Received March 4, 1954.