run for artificial mixtures of the clay minerals, kaolinite and dickite. Only the portions of the curves between 500° and 800° C. are shown in this diagram. The vertical coordinate for each curve indicates the relative intensity of endothermic reaction. The amplitude of the peaks is related to the percentage of the mineral present.

Two significant improvements in the technique of thermal analysis are evident with this type of apparatus. First, there is saving in time by running 6 instead of a single specimen. In an 8-hour day, 18 samples can be run conveniently. Second, there are certain inherent advantages in the simultaneous recording of 6 samples.

Discrepancy in Analysis of Penicillin in Blood by the Oxford Cup Method as Revealed by the Paper Disc Technique

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It is well known that low results are obtained when penicillin is assayed in the presence of blood by the Oxford cup procedure. We have found that this is not the case when the filter-paper disc technique is used. Under the same conditions, the latter method gives results close to the theoretical.

In the experiment to be described, three solutions were prepared by adding 0.5 ml. of concentrated penicillin in phosphate buffer to 4.5 ml. of the following blood fractions: defibrinated whole blood, oxalated blood, and serum. In subsequent dilutions for assay purposes, the ratio of the blood protein was maintained at a constant level of 90 per cent by using as diluent 90 per cent blood fraction and 10 per cent phosphate buffer. The resulting solutions were assayed against a standard solution of penicillin in 0.11 M phosphate buffer of pH 7.34. The technique described by de Beer and Sherwood (*2*) was used for the paper disc assays. The Oxford cup assays, performed simultaneously on the same solutions, employed glass cylinders (5.7–5.9 mm. inside diameter and 9.9–10.4 mm. high) as reservoirs. All other details, such as the agar medium, the *Bacillus subtilis* seed, the incubation, etc., were identical for both procedures.

TABLE 1

PERCENTAGE PENICILLIN FOUND BY ASSAY

Blood preparation	Paper disc method	Oxford cup method
Defibrinated rabbit blood	97.6	33.5
Oxalated rabbit blood	92.0	39.0
Rabbit serum	89.5	66.6

The initial concentration of penicillin for each of the blood preparations was 320 units/ml. Oxalated blood was prepared by adding 2 mg. of $K_2C_2O_4 \cdot H_2O$ to each ml. of blood.

The results of a typical assay are given in Table 1.

It will be observed that in every instance the results obtained by the Oxford cup method were low, whereas the values by the paper disc method were comparatively satisfactory. The slight losses in the latter case possibly may be due to a destructive action of the blood upon the penicillin. Such an action has been demonstrated by Bigger (*1*) and confirmed by us. We have found that blood containing penicillin solutions, when allowed to stand for a week or 10 days at refrigerator temperatures, suffered losses as high as 60 per cent as revealed by the paper disc technique. Thick paper discs under these circumstances appeared to be less reliable than those cut from thin filter paper.

Similar discrepancies between the disc and the cup technique were observed when dog blood was used instead of rabbit blood. E. T. Reese, of the J. T. Baker Chemical Company (personal communication), also has found that the disc method gives higher results than the cup method on samples of fermentation medium, but that the methods are in agreement on samples of commercial penicillin.

References

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A Simple Method for Studying Friction

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A spring which obeys Hooke's law has one end fastened to a horizontal plane and the other end fastened to a body so that displacement of the body along the plane produces a horizontal restoring force in the spring. When there is sufficient displacement to produce a restoring force of greater magnitude than the maximum static frictional force between the body and the plane, and the displacing force is then removed, the spring will move the body back along the plane. The body will continue in this motion until the kinetic frictional force exerted on the body by the plane absorbs all of the kinetic energy given to the body by the restoring force of the spring.

If the kinetic frictional force above is the only force which absorbs energy while the block is moving under the spring's influence, the time rate at which the energy is absorbed will be the same as that at which the sum of the potential and kinetic energies is decreasing in the system, since this is a nonconservative system. Thus, $f\frac{dx}{dt} = \frac{d}{dt}(\frac{1}{2}mv^2 + V(x))$, where $V(x)$ is the potential energy of the spring and $\frac{1}{2}mv^2$ is the kinetic energy of the body. Since all of the kinetic energy is absorbed by the kinetic frictional force and since the restoring force of the spring is linear, the magnitude of the kinetic frictional force will be equal to the average of the restoring forces acting on the body while it is in motion after one given displacement. (Integrating both sides of the above equation for the interval $x_2 - x_1$, over which the body moves after a given displacement, since the velocity is zero at the beginning and end of the interval, gives $f \doteq \frac{1}{2}(F_1 + F_2)$, where F_1 and F_2 are the restoring forces of the elongations x_1 and x_2 of the spring.)

This offers a very simple classroom method for measuring kinetic friction when a block slides on a horizontal plane. A spring balance is used as the spring. The sliding frictional force

may be determined by displacing the block along the plane until the spring-balance force is large enough to slide the block backwards upon removal of the displacing force. A reading of the spring balance should be taken at this point. Another reading is taken after the displacing force is removed and the block has stopped sliding. (The maximum restoring force should not be so great as to give a minimum restoring force of less than zero.) The arithmetical mean of the two corrected spring-balance readings is equal to the magnitude of the average restoring force and hence will be equal to the magnitude of the sliding frictional force. In determining the coefficient of sliding friction where the change in the frictional force for a given change in normal force is used, it is not necessary to correct the spring-balance readings, since the corrections would subtract to zero.

This method may also be applied in studying the friction of a body moving on an inclined plane. In this case, the average spring-balance reading would include the component of the weight of the body along the plane.

Thermostated Cell Compartment for the Beckman Spectrophotometer

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The Beckman Spectrophotometer, as furnished by the manufacturer, is quite useful for the study of any rate process involving a spectral change. However, since most mechanism studies depend on quantitative reaction-rate measurements, thermostating of the reacting solutions in the instrument becomes essential.

Preliminary research on penicillin had shown that marked changes of ultraviolet absorption took place during its chemical degradation. These experiments indicated clearly that the acid degradation forming penillic acid from penicillin was quite complicated, with one or more conjugated intermediates existing in the solution during the reactions. Because of the large amount of effort being spent on determining the structure of penillic acid, a careful study of the mechanism of its formation from penicillin was made.[1] The temperature control necessary for this complex study was obtained by the thermostated cell compartment described below.

The construction and outward physical appearance of the Beckman Spectrophotometer should be familiar to anyone interested in this report, and therefore detailed description is not necessary. The compartment described is designed to replace the sample holders furnished with the instrument. The solvent balancing feature of the instrument requires that a solvent cell as well as the sample cell be moved into the light beam. This is accomplished by moving the thermostating jacket containing the cells back and forth inside the light-tight compartment which is rigidly attached to the spectrophotometer.

The actual compartment in a partly dismantled condition is shown in Fig. 1. In Fig. 2, scale drawings are shown, with an accompanying legend giving the essential details of the construction. The main frame, thermostating jacket, pipes, guides, cell holder, and screws are all of brass. (The most important of these are indicated by crosshatching.) Other parts, such as the inside and outside plates forming the dead-air spaces in top, bottom, and ends, plates on both sides, slide handle, and the light-tight sliding door in the top, are constructed from bakelite.

The optical system of the spectrophotometer uses a spherical mirror in an off-axis position to focus the monochromatic

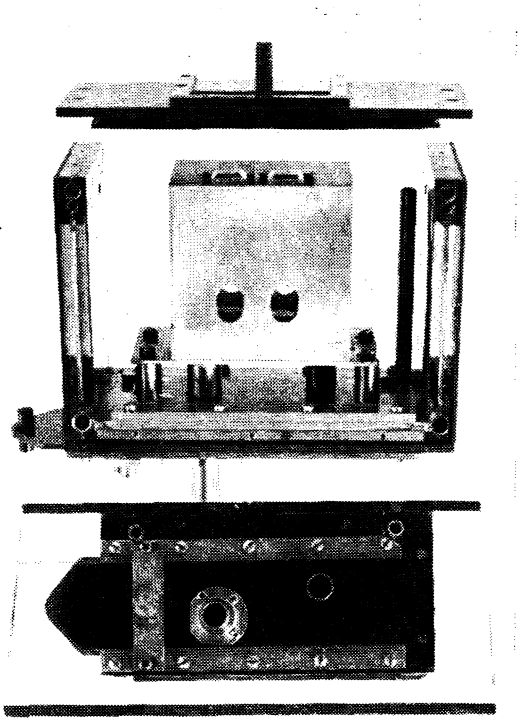

FIG. 1. Thermostated cell compartment with sides removed and the top in an exploded position, and a mirrored view of the bottom.

light on the exit slit. This arrangement gives a divergent exit beam, the dimensions of which are shown by (1) and (13). The position for the absorption cells was chosen where this beam was nearly square in shape, making it possible to use cells with the same sample thickness but completely blocking the beam with only 0.5–0.75 cc. of solution. The space occupied by the cells (8) is located at one side of the water jacket to keep as small as possible the distance between the cells and the photocell detector. This feature minimizes the errors due to light scattering from the cells and solutions.

Since this equipment was designed to be useful several degrees above or below room temperature, certain insulating features were necessary. By the use of multiple walls, the dead-air spaces (5) were created. Also, the compartment was insulated from the spectrophotometer and the phototube compartment by bakelite plates with only small openings for the light beam. If the cell compartment was being maintained at a temperature much below that of the room, the problem of frosting of the absorption cell windows had to be overcome. To do this, space was allowed for desiccant, and drying gas

[1] The results of this work were reported at the Atlantic City meeting of the American Chemical Society, April 8–12, 1946, and will be published shortly.