metal, indicating that the ions are bound with a comparable stiffness. A precise measurement of this shift as a function of temperature could be used to obtain quantitative information about this stiffness (*13*).

In general, it appears that the Mössbauer effect can readily be observed for atoms in surface sites of materials with high specific surface areas, and that it can be used to study both the chemical state and the dynamics of such atoms.

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Electrical and Thermal Measurements with Bridgman Anvils

Abstract. *Multiple probe electrical and thermal measurements at high pressures can be made routinely with Bridgman anvils by using epoxide adhesive rings.*

The use of Bridgman anvils (*1*) to attain high pressure is attractively simple, but the method has limited versatility. Success of this technique depends upon use of a ring, traditionally of pyrophyllite, that will contain the sample and yet permit relative motion of the anvils so that the sample may be compressed. Since pyrophyllite is quite fragile and the ring must be very thin, electrical contact with the sample can be made only by the two anvils. Attempts have been made to use split rings to introduce additional leads into the pressure cavity but the technique is not an easy one (*2*). We have found that the substitution of an appropriate epoxide adhesive for pyrophyllite as the ring material increases greatly the versatility and usefulness of the Bridgman anvils. Rings made of epoxide are rugged, easy to prepare, possess excellent electrical properties, and make it very simple to introduce several additional leads. Since different metals may be used readily as leads, new experimental possibilities become available.

Eccobond 104 epoxide adhesive (*3*), a viscous liquid when initially prepared, is spread onto teflon blocks and cured in thin sheets (0.02 to 0.10 cm thick) from which the Bridgman gaskets are made by machining or punching. Such gaskets have been used in two standard geometries: anvil flat 0.65 cm, sample 0.35 cm and anvil flat 1.25 cm, sample 0.65 cm diameters.

Their suitability for high pressure work was tested by examining the I-II and III-IV transitions of bismuth embedded in silver chloride. With the smaller anvils the lower transition occurs at a nominal pressure (applied force divided by area of anvil flat) of 24 kb (currently accepted value 25.4 kb) and the higher bismuth transition at 80 kb. When KCN is used as the pressure medium the I-II transition occurs at about 20 kb. The relationship between the nominal pressure and the true pressure depends upon the nature, loading, and geometry of the sample. With gaskets made from an isotropic material (for example, epoxide adhesive) pressure multiplication is often found (*4*).

Electrical leads are introduced into the high pressure area by casting the leads directly in the epoxide. This is done by fixing a teflon pin on the teflon block, running wires from the pin, and spreading the epoxide over the wires and around the pin. After curing, the pin is removed, leaving a hole for the sample. The wires protruding into the hole are cut as desired. Chromel and alumel wires of 0.025 cm in diameter have proved satisfactory. It appears that metals which do not "cold work" too rapidly and have a high ductility are suitable as leads.

Figure 1 shows the resistance as a function of pressure for copper phthalocyanine. The measurements were made with leads brought out through the epoxide gasket. The change in d log R/dP at a nominal pressure of 45 kb is associated with a phase transition (*5*).

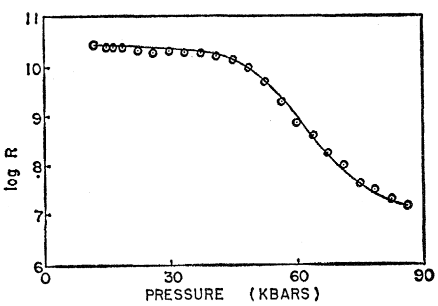

Fig. 1. Resistance of copper phthalocyanine as a function of pressure.

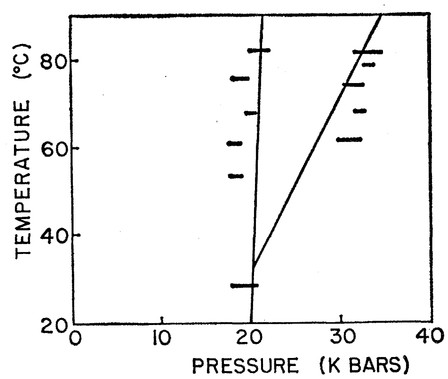

Fig. 2. Phase diagram of KCN determined by observing transition heats. Bridgman's results shown by solid line.

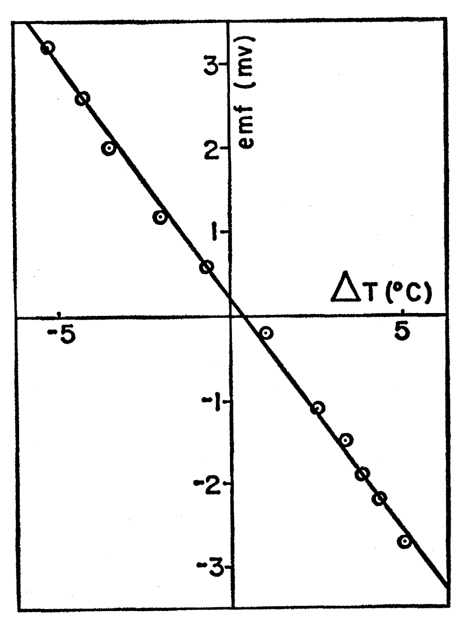

Fig. 3. The thermoelectric electromotive force of copper phthalocyanine at 20 kb.

Since leads of different metals may be used with our technique, it is now possible to locate a thermocouple in the sample under pressure. The results of thermal analysis performed on KCN are shown in Fig. 2. The bars indicate the pressure range over which an alumel-chromel thermocouple at the center of the sample showed an evolution or absorption of heat. Bridgman's results are shown by the solid lines (*6*). The heats of transition were observed at constant temperature and with decreasing pressure. The sensitivity of the system, when an L and N No. 2284 galvanometer is used, is such that the quasi-adiabatic heating or cooling which occurs with sudden pressure changes of 300 bars is easily detectable.

By incorporating two thermocouples and producing a temperature gradient along the sample, the Seebeck coefficient may be obtained. In Fig. 3 the thermoelectric voltages of Cu phthalocyanine as a function of the temperature gradient at 20 kb are shown. The Seeback coefficient is 0.6 mv per degree Centigrade. The thermoelectric electromotive force was determined by the same thermocouples used to measure the temperature gradient, thus eliminating errors due to uncertainties in ΔT. No correction was made for the effect of pressure on the thermocouples since this is probably small (*7*).

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Giant Polytene Chromosomes in Hypodermal Cells of Developing Footpads of Dipteran Pupae

Abstract. *Large hypodermal cells with giant polytene chromosomes are present within the developing feet of* Sarcophaga *and other fly pupae. The cells secrete a large volume of cuticle; at this time there is extensive "puffing" of the chromosomes. Being hypodermal and superficially situated with permanent secretory products, the cells could be ideal experimental and genetical tools.*

The giant polytene chromosomes of flies have been one of the major sources of information on chromosome structure. These giant chromosomes have been obtained almost exclusively from various internal tissues of fly larvae; polytene chromosomes have also been found in the nurse cells of adult ovaries (*1*). Giant chromosomes have not previously been recorded in fly pupae, nor in external cuticle-secreting hypodermal cells of any developmental stage. It has now been observed that in the pupae of cyclorrhaphan Diptera, the developing footpads contain large hypodermal cells in which polytene chromosomes appear shortly before the cells become active and secrete adult cuticle. The diameter of the chromosomes exceeds that of the salivary gland chromosomes of *Drosophila*, and they are comparable in clarity of detail with any giant chromosomes so far recorded.

The cells were first noted in the fly *Sarcophaga bullata*, but have since been observed in all Cyclorrhapha in which well-developed footpads are present. Footpads are also present in many of the Nematocera and Brachycera, but the presence of giant chromosomes in these suborders has not yet been investigated. Giant chromosome preparations have not previously been obtainable for most cyclorrhaphan studies which have relied on metaphase preparations (*2*).

In the fly *Sarcophaga bullata*, the foot of the adult is covered with cuticle and is composed of a pair of claws, a median bristle, the empodium, and a pair of flattened, disk-like footpads or pulvilli (Fig. 1). On the ventral surface and lateral borders of each footpad are thousands of minute cuticular "tenent" hairs whose special properties allow the fly to adhere to smooth surfaces. Over the dorsal surface of the pad there are no hairs and the otherwise smooth cuticle is ridged in a proximo-distal direction. This dorsal cuticle appears as a slightly darker area in Fig. 1. The appearance is characteristic and similar in all the flies so far examined, except in *Drosophila* where the footpads are not flattened structures. Even here homologous cuticular areas may be present. Whereas each of the thousands of tenent hairs is secreted by a single hypodermal cell, the whole dorsal cuticle is the secretory product of but two flattened giant cells whose cytoplasm extends over the entire dorsal surface of the pad. The two giant cells are adjacent along the proximo-distal mid-dorsal line, and laterally and distally their cytoplasm borders on the small hypodermal cells (Fig. 2) of the pupal foot.

Early in the pupal stage the pretarsus is a simple bilobed structure, and it is during the process of transformation into the claws and footpads that rapid growth of the giant cells occurs, resulting, toward the end of the growth phase, in the development of giant polytene chromosomes within their nuclei. These chromosomes reach their maximum size shortly before the start of cuticle secretion. The nucleolus, which is granular and irregular in shape during growth, becomes more rounded and compact. The beginning of cuticle secretion coincides with distinct "puffing" of the chromosomes (Fig. 3), a phenomenon considered to be a visible expression of gene activity (*3*). Significantly, each of the many phases to the secretion of cuticle appears to be characterized by a different pattern of puffing. Granules, apparently of chromosomal origin, are

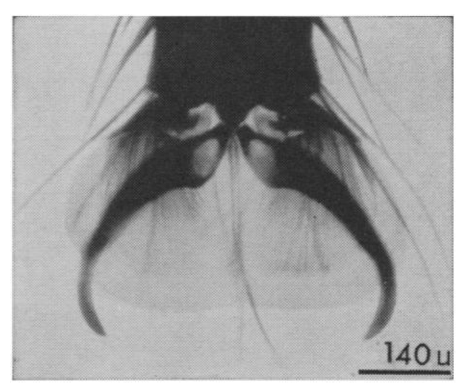

Fig. 1. Dorsal view of the fully formed foot (pretarsus) from a late pupa of *Sarcophaga bullata*, showing the paired claws, median bristle (empodium), and two flattened footpads (pulvilli). The distal and lateral edges of the footpads are lighter in color than the remainder and are composed of thousands of tenent hairs. The oval-shaped darker area is the dorsal cuticle secreted by the two giant cells.