Applications of Automatic Data Processing to a Public Health Agency's Operations

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PUBLIC HEALTH agencies were among the earliest users of various types of mechanical data processing equipment that made an appearance in this country in the 1890's. The equipment was used chiefly for processing vital records and for some of the tabulations and distributions prepared in connection with births and deaths. The early data processing machines were slow and crude and not very accurate compared to the high-speed electronic computerized systems that are standard today. But they served an important function since they represented an improvement over the conventional manual data handling systems of the time. More important, they provided the indispensable experience base upon which the larger, faster, and more versatile data processing machines were developed and built.

The New York City Health Department has had long experience, dating back 70 years, in applying mechanized data handling systems and techniques to records on births and deaths and various diseases and conditions of ill health. This paper does not deal with developments in automatic data processing of vital records or public health statistics; it is primarily concerned with recent application of ADP systems to the administrative management operations of our agency.

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Our ADP installation is primarily based on a unit card system. It comprises a key punching section with key punch machines and verifiers and a tabulating section, which includes three IBM 407 electronic accounting machines, one IBM 402, two IBM 101 electronic statistical machines, and several collators, reproducers, and counter-sorters.

The annual work input currently amounts to 1.5 million cards. Approximately one-third of these cards reflect service and performance information, one-third represent vital records data, and the remaining one-third provide management with administrative control data.

Permit Issuance and Control

For a long time unit card operations dealt almost exclusively with data on disease and with vital statistics. A good opportunity for an administrative application of ADP was presented about 10 years ago in the area of permit issuance and control. As a regulatory agency, the health department issues, chiefly on an annual renewable basis, about 55,000 permits, licenses, or registrations for wholesale and retail food establishments, restaurants, bakeries, milk and ice cream plants, clinical laboratories, day care centers, installations that are sources of ionizing radiation, and for many other trade and professional categories. Permit and registration fees vary by type of business or activity regulated and are fixed by resolution of the New York City Board of Health; the permits or licenses expire at different times through the year.

Renewal notices need to be distributed at various dates, fee payments handled, and original

or renewal permits issued. The necessity for rigid accountability to the city comptroller, who exercises an independent audit function for each permit document printed, adds to the processing load. As a result of a survey conducted by a management consultant group in 1952 (*1*), it was decided to use the data processing resources of the health department to automate as many as possible of the operations related to permit issuance and renewal.

Permits were already classified according to type of activity and fee, and each permit was individually identified with a distinctive serial number. The Sanitary Code (later renamed the Health Code) expressly provided that permits, licenses, and registrations were not transferable on change of ownership or location. Thus, the permit classification and individual permit number afforded a readymade control code on which to base automated issuance.

All file data containing permit numbers and classification codes, together with names, addresses, and types of business or activity, were key punched on standard 80-column IBM tabulating cards, producing a master permit control file. Concurrently, preprinted permit documents were converted to an IBM continuous-feed standardized form containing preprinted sequential document numbers which were issued through arrangement with the comptroller's office. This procedure permitted printing of the permit directly and automatically from the master permit file, with the type of permit indicated by coded instructions in the programing; batch-processing, possible because of staggered expiration dates, facilitated the operation.

Automation took the form of a printing of permits for each recorded permittee in advance of the scheduled expiration dates. An assembled set comprises permit, renewal notice (three copies), cashier's stub, and file copy stub for audit department, in a six-section, two-part form. Renewal notices are detached and mailed to permittees well in advance of expiration dates, and permits are validated and issued upon return of renewal applications and payments. Renewal applications must still be inspected and verified manually. A change in status of an establishment requires invalidation of its permit, notification to the tabulating division for its master file, and notice to the owner to file an application for a new permit. Invalidations are batch-processed at renewal time and at various times during the year through keypunching of finder cards, collating these with the master file, and then removing corresponding permit records from the master file. Except for such invalidations, the master permit file is maintained continuously on a current basis; renewals are presumptive and need not be individually processed.

The audit operation is maintained through the tally of fees and the sequential document numbers. All invalidated permit documents are returned to the comptroller's office as part of the audit.

This automation has effected major time and manpower savings in permit issuance and renewal and produced useful byproducts, such as selective listings of licensees and permittees to meet requirements for special control programs, special mailings, and the like. The automated permit system also provided the foundation for application of ADP to administrative control of our inspection programs.

Inspection Control

In 1952 a careful examination of procedures then in use to control inspections of wholesale food establishments revealed many defects. Some plants were being over-inspected; others were not being inspected at all. A practice had developed of filing reports showing incomplete action, uncorrected violations, or objectionable conditions without scheduling followup inspections.

Manual procedures introduced to control these deficiencies were found to be too time consuming, inaccurate, and inflexible. They also failed to meet some main objectives of the inspection program:

1. To inspect all establishments at predetermined frequencies
2. To provide expeditious followup in the inspection of poorly maintained plants
3. To assist supervisory personnel in assuring proper and prompt reinspection
4. To provide performance data in order to regulate workloads in the various health districts and to evaluate progress and effectiveness of the inspection program

5. To provide reasonably up-to-date information on conditions in all plants inspected

6. To facilitate the listings of plants by category or name and address that are periodically required.

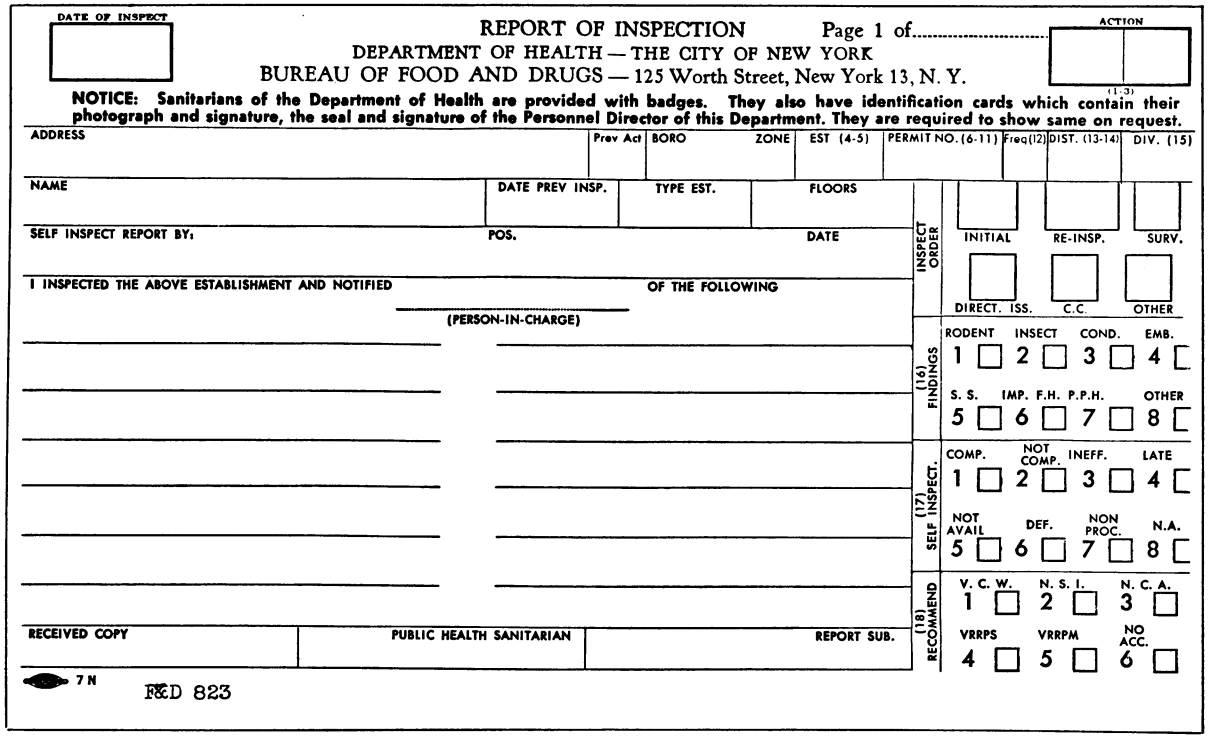
To meet these requirements some type of automated system was clearly needed. Fortunately, by 1953 the health department had fully automated procedures for issuance and renewal of permits, and all food establishments were included in the system. Thus, a punchcard was available for each such establishment, giving: (*a*) the permit number (retained by an establishment for its business life); (*b*) name and address of the permittee; and (*c*) type of operation for which the permit was issued.

From this set of permit cards it was a simple matter to select and reproduce those representing establishments under jurisdiction of the wholesale food division of the health department's bureau of food and drugs. To make the cards useful in the proposed control system, it was necessary to add three new code classifications to these reproduced cards to indicate: (*a*) the type of establishment, for example, bakery, meat processor, beverage bottler; (*b*) desired frequency of inspections per year; and (*c*) inspection district in which the establishment was located.

After the cards were prepared in the tabulating division, orders for inspection or reinspection could be scheduled and prepared mechanically. Sanitarians were instructed that no inspection was to be made without such an order.

Under the system installed early in 1957, inspection orders for each establishment under supervision of the wholesale division are issued on a predetermined cyclical basis. Reports on the inspections made are sent to the field supervisors, who code the reports either for filing or for scheduled reinspections. As completed inspection reports are filed, the tabulating division prepares new inspection orders to be held for the next inspection cycle. This procedure assures a subsequent inspection of all establishments at the proper time.

At the end of each month the tabulating division also prepares lists of the establishments in each health district for which initial and


DATE OF INSPECT

REPORT OF INSPECTION Page 1 of.....

ACTION (1-3)

DEPARTMENT OF HEALTH — THE CITY OF NEW YORK

BUREAU OF FOOD AND DRUGS — 125 Worth Street, New York 13, N. Y.

NOTICE: Sanitarians of the Department of Health are provided with badges. They also have identification cards which contain their photograph and signature, the seal and signature of the Personnel Director of this Department. They are required to show same on request.

ADDRESS | Prev Act | BORO | ZONE | EST (4-5) | PERMIT NO. (6-11) | Freq (12) | DIST. (13-14) | DIV. (15)

NAME | DATE PREV INSP. | TYPE EST. | FLOORS

SELF INSPECT REPORT BY, | POS. | DATE

I INSPECTED THE ABOVE ESTABLISHMENT AND NOTIFIED _____ OF THE FOLLOWING

(PERSON-IN-CHARGE)

INSPECT ORDER: INITIAL | RE-INSP. | SURV. | DIRECT. ISS. | C.C. | OTHER

(16) FINDINGS: RODENT 1 | INSECT 2 | COND. 3 | EMB. 4 | S. S. 5 | IMP. F.H. 6 | P.P.H. 7 | OTHER 8

(17) SELF INSPECT.: COMP. 1 | NOT COMP. 2 | INEFF. 3 | LATE 4 | NOT AVAIL 5 | DEF. 6 | NON PROC. 7 | N.A. 8

(18) RECOMMEND: V. C. W. 1 | N. S. I. 2 | N. C. A. 3 | VRRPS 4 | VRRPM 5 | NO ACC. 6

RECEIVED COPY | PUBLIC HEALTH SANITARIAN | REPORT SUB.

7 N F&D 823

Inspection form of bureau of food and drugs, New York City Department of Health

775-255—65——5

reinspection orders are pending. These lists are prepared in duplicate so that a copy is available to the sanitarian as well as his supervisor.

A number of boxes, some precoded, are provided on the inspection form for use of supervisory personnel and inspection staff (see figure). In the action box in the upper right-hand corner of the form, the supervisor fills in a number to give his instruction to the inspector, following this code:

1. Initial inspection ordered on new permittees
2. Reinspection following previous inspection
3. Serve summons on reinspection if not satisfactory
4. Reinspection following a reported "no access"
5. Inspect on monthly cycle
6. Reinspect after executive (office) review
7. Inspect on skipped or missed cycle
8. Cancel pending inspection order—out of business
9. Schedule inspection during next cycle; premises satisfactory

The supervisor gives his instruction after reviewing findings on the completed inspection form. In addition, in the same box he indicates the week of the year when the action is to be taken.

This instruction to the sanitarian is printed by the tabulating division on the subsequent inspection order; it appears in the set of boxes marked "inspect order." These boxes indicate whether the inspection is an initial one for a new cycle of inspections or a reinspection within a given cycle. The other boxes in this set were designed to record special situations but are no longer used.

When the sanitarian makes his inspection, he checks those boxes which summarize his findings, using the following code:

1. Rodents
2. Insects
3. Condemnation made
4. Embargo placed on unsound foodstuffs
5. Summons served
6. Improper food handling
7. Poor personal hygiene
8. Other unsatisfactory conditions (miscellany)

Under the New York City Health Code, all food establishments in the city are required to conduct self-inspections and to keep a record of these. The inspection form provides precoded boxes in which the sanitarian summarizes his findings in regard to this program, using the following code, with the exception of items 7 and 8, which are no longer in use:

1. Complete and effective self-inspection system
2. Not complete; significant items omitted
3. Ineffective; items listed not corrected
4. Late; self-inspection program not current
5. Not available; permittee cannot produce required report
6. Self-inspection program deferred
7. Nonprocessor
8. No access to premises

The sanitarian also checks one of the six boxes in the section on recommendations. These boxes are coded as follows:

1. Violation previously noted has been corrected
2. No sanitary inspection made
3. No cause for action; premises satisfactory
4. Violation of regulations recorded; routine cyclical inspection recommended
5. Violation of regulations recorded; premises in poor maintenance
6. No access to premises

There is also space on the inspection form for narrative reports by the sanitarian to cover situations and conditions that should be reported in detail.

Application of ADP techniques to the inspection program of the wholesale food division has unquestionably been a success (*2*). It has reduced drastically the clerical work the sanitarians must perform, permitting them to devote more time in the field to inspections. It has largely eliminated the over-inspection of some establishments and under-inspection of others, and it has given program administrators up-to-date, meaningful management control data, permitting better direction and coordination of inspection efforts.

Following this successful application in the wholesale food division, the automated system was installed in two other principal divisions of the bureau of food and drugs, the division of retail foods and the division of hospitals and institutions.

During 1963 this automated system scheduled and monitored, through managerial control, approximately 115,000 inspections in 4,000 wholesale and 44,000 retail food establishments and in 832 hospitals, schools, and institutions.

We are also seeking to develop and install an ADP system for complaints and inspections related to housing, one of the city's pressing problems. The health department shares jurisdiction in this area with other municipal depart-

ments and is making a determined effort to coordinate its service activities with the work of inspectors in sister agencies. Although it is still too early to assess the value of a pilot program started in March 1964, early findings are encouraging. We anticipate installing an ADP system somewhat similar to the one used in food inspection control to aid in the monitoring, review, and control of the 50,000 housing inspections made annually by personnel of the health department.

Purchasing Systems and Controls

From a total operating budget of approximately $43 million, the health department spends annually about $4 million, or approximately 10 percent, on what, in New York City fiscal jargon is termed "other-than-personal service" items. This category includes supplies, materials, and equipment purchased as needed for current services and activities; maintenance and repair of buildings; telephone and postage; and rental charges for leased premises.

Most purchases for New York City departments are handled centrally through a separate city department of purchase that places purchase orders almost exclusively on the basis of open competitive bids. Requests or requisitions for supplies and materials normally come to the purchase department from the operating agencies and are based upon the agencies' review of their needs at any given time. The operating agency bases its purchase orders on requisitions received from its own operating divisions and field installations, of course taking into account not only need but availability of funds.

Items in the health department's budget other than those for personal services are distributed among 53 separate codes grouped into 4 major categories. The 100 series of codes applies to purchase of supplies, the 200 series to materials, the 300 series to equipment, and the 400 series to contractual services.

The department of purchase must check purchases against the availability of funds in each code. Within the health department, purchase funds are allocated by service or bureau and further controlled by a quarterly allotment system.

The system in use before ADP was introduced entailed a vast amount of clerical, typing, and auditing work, manually performed, both in the field locations of the health department and in the purchase and audit divisions. Requisitions for individual items were typed in the department's bureaus and field locations, health centers, baby health stations, and schools; received and cleared in its purchase division; and checked with the audit division to determine availability of funds. Thereafter new consolidated requisitions were typed and forwarded to the city's department of purchase, where a somewhat similar process of review took place.

When the centralized purchase department of New York City converted to a computerized system (the IBM 1401) in July 1962, it became feasible for the health department to explore the possibility of automating purchase procedures and systems. Although full conversion to an ADP system has not yet been accomplished, significant strides have been taken.

We now use preprinted requisition forms for a wide variety of items that key into supplies stocked by the city purchase department. Typing has largely been eliminated in ordering these standard items. After the order forms are reviewed, edited, and approved, they are sent to the department of health's tabulating division, where cards are punched to provide the basic identifying data which tie into the computerized system at the purchase department. We then send these punchcards over to that department, and its personnel, with their computer, do the necessary cost extensions, update the code balances, and provide us with a monthly listing of balances in all our purchase codes. Our tabulating division uses these data to compile weekly estimates of available fund balances for each code in each bureau. Of course, the cards we send to the city purchase department are also used by its staff for internal processing, including preparation of shipping orders and delivery tickets and for inventory control. The cards are fed into a tape converter. No additional keypunching before processing is required.

We estimate that the ADP system covers about 88 percent of the dollar volume of the purchase requisitions normally processed in our agency. In fiscal 1966 we expect to extend the system to include about 95 percent of our purchase requirements.

Automation has resulted in substantial savings in clerical and typing time. In the purchase division, we have been able to release three clerk-typists for other duties; in our field locations a substantial portion of time formerly spent on requisitioning is available for other activities.

Blood Banks and ADP

New York City's system of blood supply for life-saving transfusions was characterized in the past as chaotic, wasteful, and at times dangerous. The quantity of blood needed, about 1,000 pints a day, was supplied by commercial blood banks, the Red Cross, and various hospital programs. Blood was also shipped in from out-of-town sources when needed. More than 150 separate organizations were engaged in one phase or another of collecting and supplying, as needed, human blood to hospitals and clinics in the city.

Until recently there had been no centralized control of this human blood supply, a lack which led to many serious deficiencies and hazards. For example, it was not uncommon for a surgeon to find that he did not have enough of the right blood type available for use in the operating room. A delay and frantic search would ensue. In several instances studied, although the blood was eventually obtained from out-of-town sources, the same blood type had been available in the city, but its location was unknown to staff of the hospital needing it.

Lack of centralized control also caused waste of blood, approximately 10,000 to 30,000 pints a year. To insure having an adequate supply on hand, some hospitals hoarded blood. Since whole blood under normal refrigeration has a life of only 21 days, blood stored in excess of a hospital's requirements often was completely wasted.

The defects and waste in the system of blood collection and distribution in the city demanded reform, and the New York Academy of Medicine was asked to review the facts and spell out a program of change. Based upon the academy's report after a 2-year study, the Community Blood Council of Greater New York was formed. This nonprofit organization was designed to take over most of the blood bank operations of the city and also to act as a major center for research in blood. The blood bank and research center are not yet in full operation. Eventually the center will have a large volunteer blood bank of its own with an estimated 50,000 to 100,000 donors on file. Of greater importance, it will maintain a daily inventory of all the blood available in the city. For this purpose, a computerized system employing an IBM 1440 with two random-access disk drives, plus supplementary tabulating equipment, has been installed. The center uses punchcards for input and printed reports as output. The system will serve primarily for inventory control and quick retrieval of data in the file.

Having a central inventory by type and location of all blood available from all sources in the city should virtually eliminate delays occasioned by searches for rare blood types. In addition, a list is already on the computer of 2,000 donors with fully typed blood for use in cases of rare sensitizations. Blood types of these donors have been subdivided into 47 different factors. The computer can quickly locate donors having a required combination of factors, since the whole file can be scanned in less than a minute and names of suitable donors printed out; the random-access approach is particularly suited to this task.

The computer is also, through suitable programing, capable of printing out a list of bloods by expiration date if 21 days are added to each incoming date. The blood will be used in chronological order and any surplus about to expire can be salvaged by fractionation into useful byproducts, such as plasma and gamma globulin.

The computer will also be used to keep a master file on all the center's own volunteer blood donors. Commercial blood sources take blood from professional donors who are motivated chiefly by financial considerations. These donors are sometimes difficult to locate when needed and are more likely to conceal disqualifying conditions in their medical histories than are volunteer donors. A history of hepatitis and certain other diseases or conditions, including narcotics addiction, disqualify a person as a blood donor under the New York City Health Code.

The hepatitis risk in blood transfusions re-

mains a cause of concern. A study of patients who received transfusions at University of Chicago clinics in the period July 1, 1946, to July 1, 1956, indicates an attack rate of 3 percent; the average patient received 3.4 units of blood (*3*). Mortality from serum hepatitis was 0.9 percent. No deaths attributable to this complication occurred in persons less than 36 years of age. Among those who developed hepatitis after age 40, the mortality rate was 23 percent.

Hopefully, as the community blood center builds up its file of volunteer donors, less blood will be needed from professional donors and there will be less risk of serum hepatitis from blood donors who for monetary gain conceal such disqualifying conditions as hepatitis.

It will also be possible to use the computer to predict the peaks and valleys of demand so that we can better plan for the future blood needs of the city.

Future Applications of ADP

We believe that good progress has been made to date in our agency in developing and installing ADP systems in the management phases of health programs and services. But a great many new, still-to-be developed and programed applications hold promise of significant improvement in the utilization of resources available to the health department.

One area is in the scheduling and control of the assignment of time of nursing and ancillary staff to the department's many service programs. We now employ approximately 650 professional nurses full time (registered nurses with various titles and at various supervisory levels), 250 professional nurses part time, 500 public health nurse assistants, and 20 licensed practical nurses. In addition, nurses are employed on special research or demonstration projects, and we contract for purchase of nursing service from the three Visiting Nurse Associations in New York City. The scheduling and control of time of nursing and ancillary staff for various service areas is almost exclusively a manual operation, requiring considerable professional and clerical time. Moreover, the operation does not provide top level administrators with the managerial control data they should have to best utilize the available skills and hours of their professional and subprofessional staffs in meeting all service demands.

In State and local radiation control programs, ADP and the computer offer promise of extending dramatically the comprehensiveness and effectiveness of current efforts to control radiation hazards. In New York City, about 12,000 installations are now registered with our agency under a Health Code article that requires registration of every establishment in the city having a source of ionizing radiation on the premises. Over the past 3 years we have been inspecting the equipment and premises of all registered installations, giving priority to those hospitals, institutions, and offices where we believe the greatest hazards exist. The initial inspection cycle has now been completed, and reports of our sanitarians and radiation inspectors contain quantities of data. It has been difficult to make full and effective use of the information in our files, however, because it has not been in a form that lends itself to rapid and meaningful analysis and evaluation. To get at the valuable nuggets of information buried in the material is still largely a pick-and-shovel job. A suitable ADP program, preferably computerized, for the systematic reporting and tabulation of field-collected data, would, in the opinion of the program director, yield much of value to him for program planning, development, and evaluation.

A third administrative application that appears to offer rich returns from ADP is retrieval and reproduction of vital records. Each year the New York City Health Department receives about 375,000 requests from the public for certified copies of birth and death records, for which fees are paid. Another 75,000 requests come in annually from official agencies, such as the city welfare department, the courts, and the Federal Bureau of Investigation, for searches and for copies of records. Searching files to locate the desired document and then producing a certification that it is on hand or turning out a certified copy is largely a manual operation. A large force of file clerks, record searchers, operators of photo-offset equipment, and other clerical and technical personnel is needed to keep up with the large volume of requests. We have surveyed this operation from time to time over the past decade with the assistance of sys-

tems analysts from equipment companies, but we have not yet found an economically feasible way to automate it. The barriers to an automated system do not, however, seem so formidable today as they once did. It will probably soon become economically feasible, as it is now technologically possible, to convert this document-search, retrieval, and reproduction operation from one that is largely manual to an automated system.

Summary

The New York City Health Department has had experience with mechanical data processing equipment for 70 years. Until fairly recently, the agency used automatic data processing systems chiefly to compile service data and statistics on communicable diseases and in recording, processing, and tabulating births and deaths. More recently, ADP systems have been developed and successfully installed in the administrative and business management operations of the department. The ADP systems outlined in the paper include: (*a*) an automated system for issuance and renewal of permits and licenses for businesses and establishments under the department's jurisdiction; (*b*) a system to monitor and control inspections of retail and wholesale food establishments that operate under permits issued by the department; (*c*) an application of ADP to the purchasing of supplies and materials; and (*d*) the use of ADP and a computer in operations of a community blood bank.

REFERENCES

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(*3*) Allen, J. G., and Sayman, W. A.: Serum hepatitis from transfusion of blood. JAMA 180: 1079–1085, June 30, 1962.

Applying Physics to Dentistry

Techniques and instruments of the solid-state physics laboratory will be used against dentistry's two major problems—tooth decay and degeneration of the bone that supports the teeth in a pioneering research approach by New York University scientists. They will explore the chemistry and physics of the structures of enamel and bone at the molecular level.

It is hoped that many techniques of modern physics will provide information on the way in which hard tissues become calcified. While the gross chemical composition of mineralized tissues has been determined, the exact relation of atoms to each other is not clear.

The search for basic knowledge requires an interdisciplinary approach. As part of the project, the process of mineralization will be studied in one-celled animals which form calcified outer shells as well as crystals within the cell. Using microsurgical procedures, portions of the cell that mineralize will be removed at various stages and analyzed. These parts may be transplanted into other cells to see what changes occur under the influence of a new environment.

The host-parasite relationship manifested in infectious diseases of the bones and teeth will also be studied by investigating electrical and mechanical changes that occur in both the involved tissues and the attacking infectious agents.

The National Institute of Dental Research, Public Health Service, awarded an initial grant of $102,003 to New York University. The National Advisory Dental Research Council has recommended support for the project for 3 years.