BIOTELEMETRY IN THE 1970'S

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Summary A date cannot be pinpointed for the concept of using telemetry for acquiring biological data; however, it is known that the birth of biotelemetry in the form of hardware occurred about 1921--with the report of a heart sound transmitter. Biotelemetry matured only slightly from the twenties to the early fifties. During the fifties and sixties large amounts of money were administered through the money pipeline of the federal government. As a consequence, the growth during this period was bath rapid and grotesque, with tentacles reaching into scores of industrial and educational institutions. Duplication of efforts was quite common during this period and hundreds of miniature biotelemetry systems were built, but results deriving from practical application were quite limited. During the last few years, much of the chaff was shucked from this new growth, a root system developed, and biotelemetry found limited use as a tool in clinical medicine and in medical research. In the past biotelemetry has not lived up to the expectations. What about the future--will it really occupy an important place in clinical medicine and medical research? What is the economic outlook--how many jobs will it support? Which areas will require new talent? And, finally, what are the most common problems and haw can they be solved?

Areas of Application Biotelemetry is currently employed in areas ranging from the transmission of electrocardiograms of patients in ambulances to studying wildlife migrations. Table 1 lists areas in which telemetry is currently employed in the collection of biological data.

TABLE 1

1. Research in blood pressure and blood flow control mechanisms
2. Research in the development of hypertension
3. Wildlife migration
4. Physical education studies
5. Man and animals in space
6. Effect of obedience and aggression training on blood pressure and flow in dogs

7. EKG from ambulatory heart patients
8. Biological parameters from parachutists
9. EEG from ambulatory epileptic patients
10. Temperature and EKG from social groupings of dogs
11. Gastrointestinal information from humans
12. Renal hemodynamics from dogs during exercise
13. Transmission of EIG from patients in ambulances

Except for the clinical application, much of this equipment has been specially fabricated for the particular job and consequently a considerable duplication of hardware development has often occurred. Future projects in which expansion will likely occur are listed in Table 2.

TABLE 2

1. Research in wildlife migration and physiology
2. Research in the development of hypertension and the attendant control mechanisms
3. Clinical application
4. Drug testing and evaluation
5. Meat production

The use of biotelemetry in studies of migrations and of the physiology of the animals involved in such migrations will very likely continue for the next several years. Both the National Aeronautics and Space Administration and the National Science Foundation are scheduled to support work of this type. It is proposed that orbital satellites will eventually be a part of this effort and will function by sampling and relaying information on the position and heading of such migrations.

Biotelemetry to study progression of chronic hypertension will surely be supported because of its relevancy to this problem in man. As a subeffort in this area, the use of totally implanted equipment to monitor organ implants may be common in the future. These areas of investigation can quite feasibly be dealt with by the use of implant telemetry.

Clinical use will expand as telemetry becomes more reliable and further accepted by medical personnel. Once reliable long-term operating implanted telemetry devices are fully developed, the use of implanted animals for drug evaluation could expand vastly as anesthesia and restraints became unnecessary, permitting a better evaluation of the drug effects.

The use of telemetry as an aid in food production is intriguing because of the potential economic impact. It appears that chickens and swine raised in high density environments tend to develop sclerosis. In the case of chickens, this might well impair laying efficiency; and in the case of swine, it sometimes leads to death prior to marketing. If biotelemetry could be used to get at the basic cause of the problem and to aid in alleviating it only slightly, a significant economic impact might well be realized.

Economic Outlook Medical equipment sales are currently a multimillion dollar business. Of this total sales, clinical biotelemetry, even though it is yet in an evaluation stage, totals on the order of $10 million a year. Research telemetry purchases total about $3 million a year. In the general area of biotelemetry, it is estimated that the government spends from $2 to $5 million a year in supporting application and development. The yearly level of biotelemetry is thus on the order of $20 million a year. On this basis one could predict that there are currently no more than 2,000 jobs principally related to biotelemetry. Of the 7,000 plus hospitals and the roughly 300 major educational institutions, most have several jobs which are supported in part by certain aspects of biotelemetry. One can therefore estimate that the total number of jobs directly and indirectly related to biotelemetry are in excess of 20,000.

If clinical telemetry passes the present evaluation testing, this number will swell considerably during the next several years. It is difficult to see that the number of jobs directly related to biotelemetry will exceed 10,000 in the next few years, as this would require a base of support exceeding $100 million a year. Jobs of an indirect nature may well increase to 100,000. On this basis, one can predict that biotelemetry is here to stay and that it will support a substantial number of jobs.

Many problems have yet to be solved. Reliability in clinical areas remains a considerable area of concern. Low power radiation has often resulted in the loss of signals from patients and much confusion. This coupled with what the manufacturer considers improper application by the user and what the user considers improper design by the manufacturer has resulted in clinical telemetry being applied slowly. Efforts to eliminate these problems within a fixed economic framework are paramount. Simpler, more reliable, lower maintenance equipment is very much needed and standardization of equipment is a highly desirable goal. In the reasearch area the major equipment problems appear to be in sensor design. Sensor stability is totally inadequate for conducting unattended chronic experiments. In implant telemetry the large size of the electronics and power sources prevents application to small animals. New high density designs are technologically feasible, but economically impractical because the low sales volume will not support tooling expenses.

Conclusions The use of telemetry as a research tool in biology and in physiology will expand. The overall economic impact will be moderate, building up to perhaps several tens of a million dollars within the next several years. The potential economic impact of clinical telemetry is greater by at least one order of magnitude. However this potential will be obtained only if the use of telemetry in clinical areas evolves as a valuable contribution to the basic delivery of health care and if technology, talent, and capital are applied in sufficient quantities to solve the problems encountered in shifting from theory to practice.