In a recent review Ivy (1) has noted the lack of quantitative information concerning important functions of the digestive system of the aged. Study of the normal physiologic functions of old people is basic to all phases of geriatrics. The present investigation was undertaken to determine what effect, if any, the aging process has on gastric emptying.

During the past few years the senior author and his colleagues have determined, under controlled conditions, the gastric emptying time of 59 vigorous, young men. These data have been of invaluable help in the present study, since they serve to establish a criterion for the emptying time of the stomach of young adults in their physical prime. The data obtained from the studies of gastric emptying of the aged group reported in this paper could be compared directly to those obtained from the young adults.

Method. Twelve men, the youngest of whom was 58 and the oldest 84, and whose average age was 76.8 years, were used for this study. Ten of the twelve subjects were indigents residing in the county infirmary; one was a college professor; one was a janitor.

At 7:30 a.m. they were given a high carbohydrate test meal similar to that used in previous studies (2). This meal consists of 15 grams of Quaker Farina and 350 cc. of water, boiled together and evaporated to 200 cc.; 50 grams of barium sulfate were added so that the position of the meal could be observed fluoroscopically. No food had been eaten since the preceding evening. The subjects were instructed to relax mentally and physically, but were allowed to walk around the laboratory if they so desired. The same methods were employed in all respects as for the estimations of gastric emptying time of young adults.

With the exception of 2 subjects, at least 3 determinations of gastric emptying time were made on each individual at exactly weekly intervals, to establish the mean for each subject. Time of emptying of the stomach as ascertained by fluoroscopic observation was determined to the nearest 10 minutes.

Results. The results are expressed graphically in figure 1. The mean values for each of the aged subjects are superimposed upon a diagram of
distribution of the individual mean values for 59 young adults. The average length of time for the test meal to leave the stomach in the 12 old men was 1.94 hours, with extremes of 1.33 and 2.75 hours. The median value was 2.04 hours. The gastric emptying time of the 59 young adults averaged 2.08 hours, with extremes of 1.03 and 3.08 hours and a median value of 2.06 hours. It is apparent, without statistical analysis, that there is no significant difference between gastric emptying times of the 2 groups.

Discussion. Recently it has been pointed out (3) that gastro-intestinal symptoms are common in old age although gastro-intestinal disease is relatively uncommon. None of the subjects used for the studies reported in this paper, as far as could be determined, suffered from organic disease of the gastroenteric tract or complained of gastric disturbances at the times the observations were made. They had normal appetite for food and regularly ate three meals each day. None suffered from cardiac embarrassment or other apparent causes of anoxic or stagnant anoxia, which could affect gastric emptying. All had sufficient cardiac reserve to perform light, physical tasks without distress. All but 2 cooperated well during the 4 weeks interval of study.

The subjects remained indoors during tests, since external environmental temperature may influence gastric emptying. The observations were made during December and January, while those on the 59 young adults were made during the cool months from October to May; thus was offered some degree of control of any possible seasonal variation in gastric emptying time.

Any greater activity of the younger group during the evening preceding the test meal, which is a factor difficult to control, presumably had little ef-
feet on mean values. If activity were greater, it should cause hunger, and Ivy and Fauley (5) have shown that hunger decreases gastric emptying time in experimental animals. The results indicate, however, that the younger group did not have a shorter gastric emptying time.

An interval of 7 days between tests is sufficient to rid the intestinal tract of all traces of barium sulfate. If much shorter periods were used, it is possible that a mass of barium sulfate in the lower intestinal tract could reflexly impede gastric emptying. Reflexes from the colon have been shown by Pearey and Van Liere (6) to influence gastric motility.

Meyer and Necheles (3) have reported that no free acid was found in the fasting stomachs of 65 per cent of 29 patients over 60 years of age, and that salivary, gastric and pancreatic secretions were reduced in amount and content of enzymes, except for pancreatic amylase. An achlorhydric stomach may empty faster than the normal, but Ivy (1) has noted that this is not definitely proven. None of the 12 subjects was willing to submit to tests of gastric acidity, but even if it is granted that the majority were achlorhydric, the results still indicate that the gastric musculature of the aged is capable of exerting vigorous and effective peristalsis.

In the present small series, no correlation was observed between physical vigor and gastric emptying time. One of the least vigorous subjects had the most rapid emptying time.

Although there is no difference between gastric emptying times of old people and young adults, this should not be interpreted to mean that the aged should eat as much or even the same quality of food as is eaten by healthy, young adults. An assumption that gastric emptying time is a main criterion for eating habits is unwarranted, particularly in view of diminutions in the aged of secretions of the various digestive organs (3). Also, since many people past middle age lead sedentary lives, obesity results if eating habits are not suitably modified, and life expectancy may thereby be decreased.

SUMMARY AND CONCLUSIONS

The normal gastric emptying time of 12 men, the youngest of whom was 58, the oldest 84 and whose average age was 70.8 years was determined fluoroscopically. None of these subjects had demonstrable organic disease of the gastrointestinal tract, and all were capable of performing light, physical tasks. The determinations of the gastric emptying time were made exactly at weekly intervals.

The criterion used for establishing normal gastric emptying time was the data secured from 59 vigorous young adults, who had been given the same type meal and subjected to exactly the same procedures as were the aged subjects.

The gastric emptying time of the 12 old men was 1.94 hours; the extremes
ranged from 1.33 to 2.75 hours. The gastric emptying time of the 59 young adults was 2.08 hours with extremes ranging from 1.03 to 3.08 hours. It is concluded that gastric emptying is not influenced by senescence.

REFERENCES

(6) Pearcy, F. J. and E. J. Van Liere. This Journal 78: 64, 1926.