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What Happened at Hawthorne?

New evidence suggests the Hawthorne effect resulted from operant reinforcement contingencies.

H. M. Parsons

In the folklore of behavioral science, the Hawthorne effect is cited again and again to show how variables can be unwittingly confounded in an experiment because of some aspect of the experiment itself. Certain independent variables were manipulated in the Hawthorne studies, but subjects' response rates supposedly rose regardless of any particular manipulation. Although this article will question that supposition, there was indeed a Hawthorne effect. Undoubtedly something other than what the experimenters explicitly introduced made workers' productivity increase. But what was this extraneous variable?

It is time to reexamine the Hawthorne effect in light of more recent research in human behavior, rather than speculate about the effects of morale, milieu, supervision, and group influences—although these will be discussed later. This article directs attention to circumstances in the Hawthorne experiments hitherto unreported or disregarded. A variable that had remained in obscurity emerges: the consequences of responding. The variable consisted of information feedback coupled with financial reward. Operators were told what their output rates were, and the higher the rates, the more money they earned. This interpretation of the Hawthorne effect has not been previously advanced (*1*), if only because it was not realized that the workers received knowledge of results on a daily, or even more frequent, basis.

Seven studies—not the one or two frequently mentioned in secondary sources—took place between 1924 and 1932 at the location from which the research drew its name, the Chicago plant where the Western Electric Company manufactures equipment for the Bell Telephone System. All seven were concerned with workers' productivity—their response rates. One should recognize and admire the considerable scope and pioneering nature of this research, regardless of the difficulties the investigators encountered and the myths that have accumulated over the years.

One of the myths surrounds the first three studies, which tried to determine how changes in illumination would affect the production rates of girls who inspected parts, assembled relays, or wound coils. In most cases, the subjects were reported to have worked progressively faster, regardless of changes in illumination, and some authors of secondary sources have referred to these studies as the locus of the Hawthorne effect (*2*). But is such emphasis justified? These early investigations were the impetus for the later ones and for that reason were briefly described in the principal account of the Hawthorne research (*3*). But the only published source for that account was a 12-paragraph news report (*4*) and a Western Electric memorandum (now unavailable) describing a supplementary "informal" study (*5*). No report of the research that satisfied elementary requirements of scientific description—quantitative data and experimental operations—was ever issued (*6*). The myth lies in the implication that weighty conclusions rested on sufficient evidence.

Relay Assembly Test Room Experiment

The actual source of the Hawthorne effect, the Relay Assembly Test Room experiment, lasted from 25 April 1927 to 18 June 1932. It contained 24 experimental periods in which two independent variables were manipulated (*7–11*). These were rest pauses and duration of work (*12*). Five girls performed tasks that required procedural memory and visual discrimination, finger dexterity, and hand-eye and hand-hand coordination. (A layout operator kept the others supplied with parts and assigned them work.) A relay consisted of as few as 26 parts or as many as 52, but generally between 34 and 38 (half of them dissimilar). To assemble one, a girl would take parts from a basket, an armature rack, and a coil box; reject faulty parts; arrange the parts in a jig and hold them together with pins; and, finally, replace the pins with four machine screws. One analysis showed 32 motions of the right hand and 31 of the left, 21 of each set being at the same time. According to Whitehead (*10*, pp. 62–63), "each operator employed several dozen different working patterns during the test" and "each operator showed a strong tendency to assemble relays in short runs or groups, each run typically containing anything up to about 10 consecutive relays." Operators had individual styles and tempos. Adjoining runs had different average speeds.

Over the course of the experiment, each operator assembled more than 100,

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perhaps more than 150, different types of relay. Since some relays took longer to assemble than others, the Western Electric Company had conversion factors whereby rate for each type could be converted to rate for a "yardstick" relay. This equated the rates for different types but not the frequencies of shifting from type to type, which an operator might do two or three times a week. Whitehead (*10*) said that changing the type had no immediate effect on rate. But one operator who for some reason had many more different types of relay to assemble than the others tended to maintain a more constant rate.

The subjects were experienced operators (except at the very end of the experiment), unmarried (although one married during the experiment), and they did not remain the same across conditions, an experimental misfortune disregarded by most secondary sources (*13*). Two of the five critical operators were replaced during the first part of period 8 because they had persisted in talking too much while they worked. The girls were permitted to talk more in the experimental situation than in their regular department, but these two overdid it. Both the observer-supervisor and the other girls felt they should go. Their output rates were dropping, and therefore the group's rate dropped. Their persistence after being warned was viewed as insubordination. Their replacements started out with much higher rates. One of these, who became the group's unofficial leader, was described by the observer-supervisor as its quickest, most intelligent, most ambitious, and most responsible member. Another operator was replaced by a slower worker in the middle of period 14. Since changes in subjects made averaging across subjects invalid for some comparisons, it is necessary to turn to individual records, which varied from person to person.

Independent Variables

Manipulations of the independent variables of rest pauses and hours of work are shown in Table 1. During the first period, data were taken on the girls' production rates in their regular department without their knowledge. They spent the subsequent periods in the experimental location, a separate room with better lighting, fans during the summer, and a friendly and tolerant observer as supervisor instead of an authoritarian foreman (*14*).

With the start of the third period, and for the rest of the experiment (*15*), the girls were paid by a new method. The previous method, in their regular department, was a somewhat complicated system of collective piecework payment. Each worker received, above a guaranteed hourly wage, a sum based on the amount by which the production of the department as a whole exceeded the total guaranteed-hourly-rate earnings of its members, the department being credited with a fixed sum for every unit produced (*16*). Under the new method, the collective unit became just the five in the experimental group (with the sixth prorated) instead of a department of 100 or more. Now each girl's earnings were based on the productivity of the five together above their collective hourly wages (which remained constant). Because of the reduction in unit size from 100 to 5, "each girl received an amount more nearly in proportion to her individual effort" (*8*, p. 639).

Rest pauses were introduced in period 4 and varied in periods 5, 6, and 7. Duration of work was varied in periods 8, 9, and 11. Period 10 had the same conditions as period 7, which became the standard set of rest pauses for the duration-of-work variations. Period 13 also had the same conditions as period 7 (*17*). Period 12 had the same conditions as period 3, with *no* rest pauses. The conditions in period 14 resembled those in period 11. Period 15 resembled periods 7, 10, and 13. In period 16 the operators exchanged positions, and they resumed their earlier places in period 19.

In addition, "For part of the time, each operator was daily tested to make a few relays as fast as she could" (*10*,

Table 1. Conditions in the Relay Assembly Test Room experiment. [Data for periods 1 through 13 from Roethlisberger and Dickson (*3*)]

Period number	Special feature	Dates included	Duration (weeks)	Times of rest pauses	
				a.m.	p.m.
1	In regular department	4/25/27 to 5/10/27	Approx. 2	None	
2	Introduction to test room	5/10/27 to 6/11/27	5	None	
3	Special group rate	6/13/27 to 8/5/27	8	None	
4	Two 5-min. rests	8/8/27 to 9/10/27	5	10:00	2:00
5	Two 10-min. rests	9/12/27 to 10/8/27	4	10:00	2:00
6	Six 5-min. rests	10/10/27 to 11/5/27	4	8:45, 10:00 11:20	2:00, 3:15 4:30
7	15-min. morning lunch and 10-min. afternoon rest	11/7/27 to 1/21/28	11	9:30	2:30
8	Same as 7, but 4:30 stop	1/23/28 to 3/10/28	7	9:30	2:30
9	Same as 7, but 4:00 stop	3/12/28 to 4/7/28	4	9:30	2:30
10	Same as 7	4/9/28 to 6/30/28	12	9:30	2:30
11	Same as 7, but Saturday morning off	7/2/28 to 9/1/28	9	9:30	2:30
12	Same as 3 (no lunch or rests)	9/3/28 to 11/24/28	12	None	
13	Same as 7, but operators furnish own lunch, company furnishes beverage	11/26/28 to 6/29/29	31	9:30	2:30
14	Same as 7, but Saturday morning off		9		
15	Same as 7		31		
16	Same as 7, but operators changed positions		4		
17	Same as 16, but 4:15 stop and Saturday morning off		25		
18	Same as 17, but Friday afternoon off		15		
19	Same as 18, but operators back at previous positions		15		
20	Same as 17		25		
21	Same as 20, but Monday off		3		
22	Same as 17; near end, same as 21		9		
23	(No information)				
24	Apprentices as subjects	? to 6/18/32			

p. 28). Although no source contains any quantitative data on these "racing" times, their occurrence shows that the operators were otherwise not working at maximum speeds.

Various conditions that remained relatively constant during the experiment differed from those in the regular department. Location and supervision have been mentioned already. The girls received periodic physical examinations. They met occasionally in the office of a plant executive, a unique occurrence, to discuss the experiment. They were consulted about future experimental conditions and were told at the outset that the experiment aimed to find out whether rest pauses and a shorter working day were desirable, as well as to probe employees' attitudes toward work and company, fatigue effects, and afternoon falloffs in production.

The girls were also told from the start not to force their output in any way, but rather "to work at a comfortable and natural pace" (*3*, p. 128). They were not urged to try to achieve a desired level of performance, called the "bogey" (*16*), as they had been in their regular department. Nevertheless, their attention was directed toward output by the nature of the experiment and by a management assurance to "tell them all we ourselves know about the results as we went along" (*3*, p. 32). At one point, the observer-supervisor asked the girls why they did not try to increase their output by 10 percent. As Whitehead (*10*, p. 114) remarked, "Both parties to the experiment had their eyes on output rates."

Data Collection

A special method was developed for collecting data on output rate in the test room—another difference between it and the regular department. Each completed relay was dropped down a chute next to the operator who assembled it. When a flap opened, an electrical pulse went to a device that punched a hole in a paper tape. There were five hole locations, one per operator. This recording apparatus was situated just behind the operators, who worked side by side at a long table. In addition, a separate counter for each operator accumulated the totals of completed relays. The counters were near the paper punch (visible to any operator at any time she wished to get up and look at them), and readings were taken from the counters every half hour (*18*). At the end of each day, a report specified the total number of relays each worker had completed, type of relay, total time for sets of 50, and time breaks. This record went to the payroll department, but the layout operator also kept it for the relay assembly department's file.

Another record showed parts rejected by an operator, as well as defective relays assembled, inspected, and returned to the test room. A daily log sheet detailed production time, nonproduction time, and nonproduction activities. Besides these records, the observer-supervisor kept a running record of daily outputs and a history of daily happenings, remarks made by the operators, and observations he made himself. He regularly posted the history sheets and log sheets (*9*). There were also medical records (including amount of sleep the night before) and records of temperature and humidity.

No account of this Hawthorne experiment has stated when and how often the operators received information about their output, whether from the observer-supervisor, clerk, or layout operator, or by getting up themselves and looking at the counters or half-hourly accumulated totals. Primary sources (*7–11*) made no attempt to give a systematic description of this aspect of the experiment, an omission perhaps more understandable several decades ago than it would be today. Secondary sources have not raised the question. But clues about information feedback can be found in some of the remarks the subjects made and the observer-supervisor wrote on his history sheets, as reported by Roethlisberger and Dickson (*3*) and Whitehead (*10*). For example, at about 4:30 p.m. on 19 April 1929, in period 13, Operator 3 said: "I'm about 15 relays behind yesterday." Operator 5 said, "I made 421 yesterday, and I'm going to make better today" (*3*, p. 74; *19*).

It was reading these comments that prompted me to reexamine the Hawthorne studies. Together with the data-collection arrangements and assurances to the operators that they would get as much information as anyone else, they seemed to make a good case for information feedback, even without eyewitness testimony. Fortunately, however, it has been possible to obtain such testimony from Donald A. Chipman, a longtime observer in the test room (*20*). The half-hourly cumulative records of the individual counter totals were kept on an adjacent bench and were "readily available to anyone interested in these figures." The operators did check the half-hourly output records, although not on a regular basis. It was his observation that "any individual who believed that her output for a given period was exceptional or was below par would check the records to verify this belief," although "some operators or possibly all of them might not check the half-hourly record on a given day." Of perhaps even greater significance, Chipman stated that "the daily output of each operator was reported to her at the end of the day or the following morning." Also, the operators scrutinized whenever they wished the running record of daily outputs. Probably because test room data were available to them at any

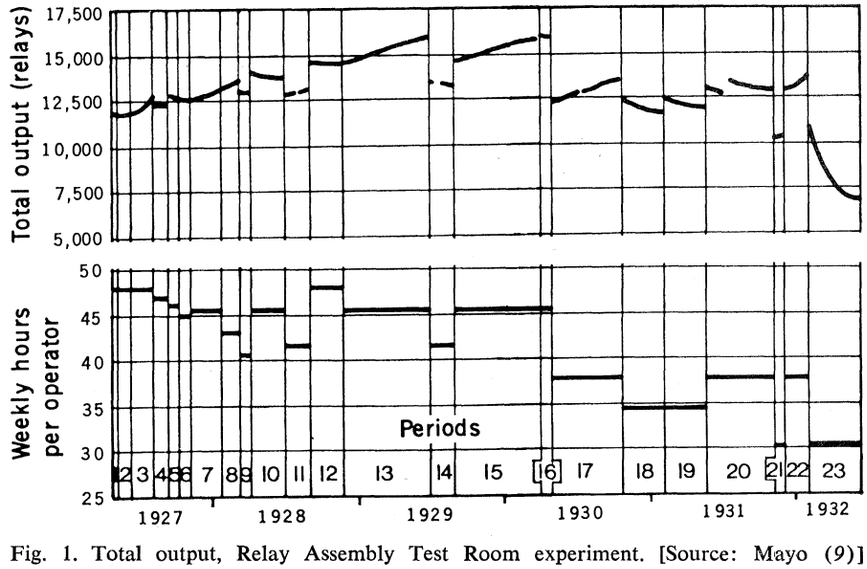


Fig. 1. Total output, Relay Assembly Test Room experiment. [Source: Mayo (*9*)]

time, he added, the girls as far as he knew did not keep their own records. In short, the operators received knowledge of results frequently and systematically.

Results

Figure 1 shows the total output of the group, along with total time worked per week. Since this method does not compare outputs directly for the same duration of working time, a better index is hourly output (response) rate for individual operators, as in Figs. 2 and 3.

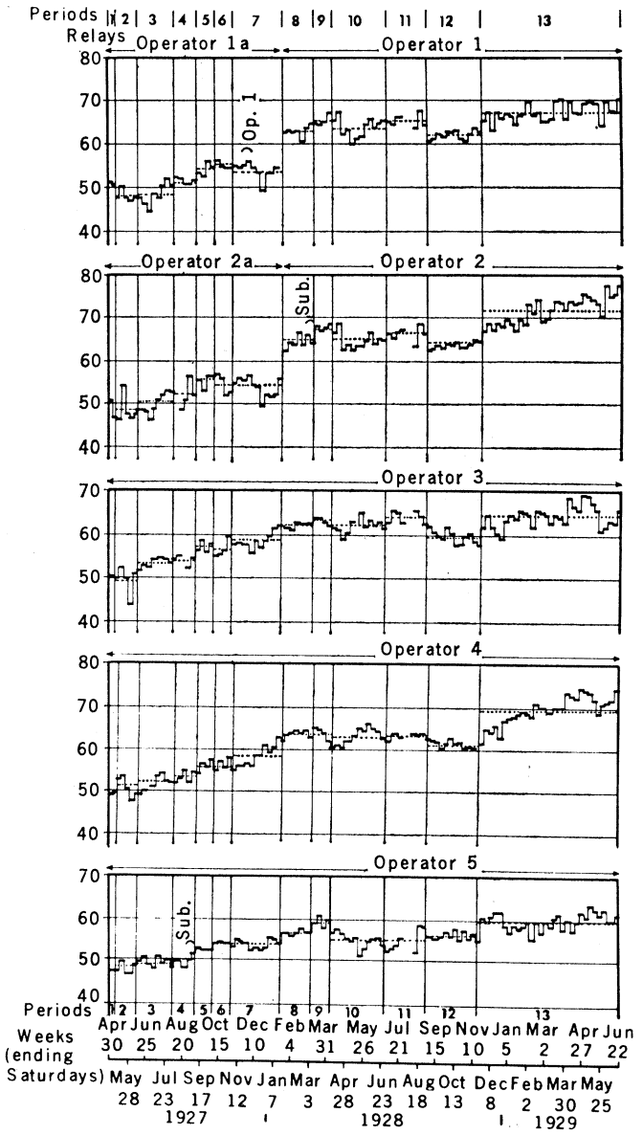
Figure 2 shows what happened in periods 1 through 13. Overall, as Fig. 3 also shows, the rate for each operator increased (although rates for the two replaced after period 7 had begun to drop again). This overall trend is the most telling outcome of the experiment, leading to the comment, "The general upward trend in output independent of any particular change in rest pauses or shorter working hours was astonishing" (*3*, p. 86); although the method of calculation was not indicated, it has been stated that the average rate for the group rose 30 percent during the first 13 periods (*3*).

The rise was not continuous, however. Output rate decreased in period 10 for all operators, and it decreased still further in period 12 for four.

What about the rates *within* conditions? With the notable exception of periods 10 and 12, and with less consistency for the operator who had a large number of different relays to assemble each week, the rates tended to rise, as Fig. 1 indicates. Although the within-period upward trends in output rate were accompanied by considerable variability between and within workers (as well as similarities within three pairs), they are reasonably apparent and must be regarded as a significant phenomenon.

What about differences *between* conditions? Although moving to the special room was followed by slightly lower rates for four operators, rates began to climb when the method of payment changed (period 3). However, the payment condition of periods 1 and 2 was not repeated to see if the earlier rates reoccurred, as should have been done to be certain that a change in conditions instead of some extraneous variable caused the change in rate (*21*).

Output rates were higher when rest pauses were introduced and hours of work shortened, and the investigators did reinstate previous conditions for



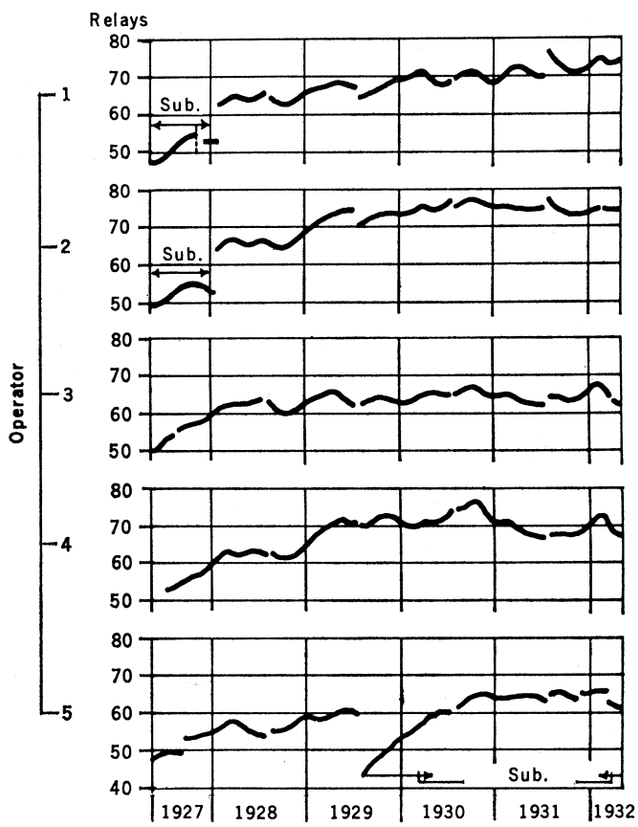


Fig. 2 (left). Hourly output rates per week, Relay Assembly Test Room experiment (*Sub.* indicates a substitute). [Source: Roethlisberger and Dickson (*3*)] Fig. 3 (right). Hourly output rates, smoothed curves, Relay Assembly Test Room experiment (*Sub.* indicates a substitute). [Source: Mayo (*9*)]

comparison purposes. Because the rates did not revert to those under earlier, comparable conditions, many persons have concluded either that rest pauses and shorter work hours had no effect or that it was impossible to demonstrate one. For example, Whitehead (*10*) called attention to the inconstancy of the output rates and asserted that, for the most part, change in rate failed to correspond with changes in experimental conditions. It seems apparent that the progressive and general increase in rates intervening between comparable periods tended to obscure the reversions that did occur. Presumably, the same process that produced the progressive increase had irreversible effects that hindered reversions to earlier rates.

Nevertheless, as has been pointed out (*3, 8*), the output rate did drop substantially in period 12, when rest pauses were eliminated. This suggests that the rest pauses had indeed had some responsibility for raising the rate earlier. Landsberger (*22*) asserted that, although the rate did not fall as low as that in period 3, it declined exactly as one would expect it to on the basis of fatigue or monotony. In another view, the data certainly failed to demonstrate that rest pauses did *not* increase productivity (*23*, p. 193). In any case, the outcome must have convinced the Western Electric Company management. It initiated rest pauses in some of the Hawthorne departments early in 1930.

In addition, the sharp decrease in output rate in period 10, when the girls went back to longer hours (standard quitting time), suggests that the shorter hours also had had an effect on the rate. But, here again, the rates did not revert to those in the earlier comparison period, period 7. This comparison was further weakened by the changes in two operator positions.

Although data for the later periods in the experiment and for other factors could also be reviewed (*24*), I have shown enough to summarize the main results. The investigators got more evidence than has generally been realized about the effects of the two independent variables they manipulated, but their principal discovery was unexpected. The overall increase in production rates yielded the Hawthorne effect. Some uncontrolled, extraneous variable was at work. The other three documented Hawthorne studies help in the search for it.

Second Relay Assembly Group Experiment

The experiment called the Second Relay Assembly Group, described by Roethlisberger and Dickson (*3*) but otherwise seldom mentioned (*25*), ran from the end of August 1928, to sometime in March 1929. It investigated the effects of the new piecework payment method adopted for the Relay Assembly Test Room experiment. No other variables were introduced.

Data on five experienced operators were first obtained at the operators' regular work stations during 1 to 5 weeks while they were being paid according to the prevailing department-wide method. Subsequently, they worked together for 9 weeks at a common bench, but not in a separate test room, under the small-group payment method. Finally, they went back to their previous method of payment, and data were collected on four of them for 6 to 7 weeks. The production rate of each operator rose with the shift to the new method of payment (about 12 percent on the average), remained steady during it, then dropped again with the shift back to the old method.

Unlike those in the Relay Assembly Test Room experiment, the rates in the Second Relay Assembly Group did not rise *during* the 8 weeks when the five-person unit for piecework payment was in effect. Apparently these operators, who remained in their department, did not have access to information about their rates as did the girls in the other experiment. Their work station lacked the counters and other devices for tallying assembled relays (*26*). In this experiment, in which immediate and average rates exceeded those prevailing before the new method of payment took effect, the investigators reinstated the earlier payment condition and the rates dropped. This finding "tended to substantiate the hypothesis that the formation of a small group for the purpose of determining piecework earnings was an important factor in the Relay Assembly Test Room performance" (*3*, p. 133).

Mica Splitting Test Room Experiment

According to Roethlisberger and Dickson (*3*) and Mayo (*9*), in the Mica Splitting Test Room experiment (22 October 1928 to 13 September 1930) five experienced female operators split, gauged, and trimmed mica that was to be used for insulation. This work demanded much skill and had taken these and other operators 2 to 3 years to learn. It required close attention and precise manual movements. It also paid well. Each operator was paid according to the number of items she produced. This payment method prevailed both before and throughout the experiment.

The planned independent variable, two 10-minute rest pauses (at 9:30 a.m. and 2:30 p.m.), was introduced at the start of period 3. There were five periods, the first at the operators' regular work stations in their department, the remainder in a special room. The environment there was very similar to that of the Relay Assembly Test Room, except that the output had to be counted by hand. The move to the special room was followed by some reduction in production rate for four operators, but after rest pauses were introduced all five operators worked faster. During period 3, four girls increased their rates progressively, although with considerable variability, while one did so at first and then leveled off; the progressive increases (except for one operator) extended into the fourth period, when external developments (*27*) were accompanied by declines of varying extent.

Roethlisberger and Dickson (*3*) concluded that the average rate before the declines was about 15 percent higher than the starting rate (presumably the period 2 baseline). Since there had been no change in the payment method, this increase might be attributed to changes in working conditions and supervision similar to the changes characterizing the Relay Assembly Test Room experiment. (It was suggested that the mica workers were initially closer to their maximum rate than they would have been had they been working on a department piecework basis and that they had fewer reserves of skill and energy to call on.) If this attribution were valid, the similar changes in working conditions and supervision could account for a 15 percent rise in productivity in the Relay Assembly Test Room. Since Roethlisberger and Dickson estimated the total increase in productivity (during the first 13 periods) as 30 percent, they deduced—with some misgivings—that the other 15 percent increase was due to the shift to the small-group

method of piecework payment. In this sense, then, the results of the Mica Splitting Test Room study, like those of the Second Relay Assembly Test Group experiment, indicated that the new payment method was responsible for much of the general rise in rate that produced the Hawthorne effect. On the other hand, the increase in the mica splittters' output occurred after rest pauses were introduced and might be attributed to this variable.

Bank Wiring Observation Room Study

The last study, systematic observation of a group of 14 male operators in the Bank Wiring Observation Room from 26 June 1931 to 28 May 1932 (*3*), incorporated no independent variables. Three soldermen, two inspectors, and nine wiremen (who could set the pace) worked on terminal banks for telephone exchanges in a special room. An early example of (self-initiated) job enrichment, the wiremen and soldermen frequently traded jobs—contrary to the rules. The men were required to observe departmental regulations, and they reported to their regular supervisors. An observer in the room and an interviewer obtained data. The output records were those regularly compiled in the operators' department, as well as the observer's independent record (*26*).

The operators continued to be paid by the department-wide piecework method. As Homans commented, this method, although complicated, seemed like a logical way to maximize productivity (*8*, p. 644):

> An individual's earnings would be affected by changes in his rate or in his output and by changes in the output of the group as a whole. The only way in which the group as a whole could increase its earnings was by increasing its total output. It is obvious also that the experts who designed the system made certain assumptions about the behavior of human beings, or at least the behavior of workers in a large American factory. They assumed that every employee would pursue his economic interest by trying to increase not only his own output, but the output of every other person in the group. The group as a whole would act to prevent slacking by its members.

Regardless of what the management thought this incentive system should have accomplished, in this study it resulted in a steady production rate. Each operator carefully restricted his output to keep it relatively constant throughout. Apparently with the full intention of doing no more, the group wired a steady two equipments per day. They regarded this as a proper day's work, although it was less than the amount called for by the bogey. By working harder in the morning, they could ration their efforts in the afternoon. The faster workers slacked off more than the slower.

If one of the operators threatened the stability of this scheme by working too fast, the others brought him into line through group disapproval. They sarcastically called him "slave" or "speed king" or used an invective. The standard practice of hitting him sharply on the upper arm was called "binging." The "rate buster" was not supposed to strike back, nor did he. Group disapproval also kept "chiselers" from working too slowly and "squealers" from saying anything that would interfere with the group's operations.

Why did the operators act this way? According to Homans (*8*), they thought that, if an excessive amount of work were turned out, the management would lower the piecework rate and the employees would therefore be in the position of doing more work for approximately the same pay. Roethlisberger and Dickson (*3*) said the operators believed the piecework rate might be raised or lowered, the bogey might be raised, someone might be laid off, hours might be reduced, or supervisors might reprimand slower-working people. In any case, the payment method did not lead to higher output through individual ambition and pressure by faster workers on slower ones. Indeed, what happened in the Bank Wiring Observation Room was characteristic of all of the employees paid by this method, as brought out in a Hawthorne-wide interviewing program instituted in 1931.

In contrast, the Relay Assembly Test Room operators not only were rewarded more directly, but were freed of the self-restraint that marked the Bank Wiring Observation Room. Because the unit for calculating piecework reimbursement was reduced from 100 or more to 5, the advantage of an individual increase in output rate was greater, and patently so. Because they felt assured that the work-payment relationships would not be changed later to their disadvantage if they worked faster, the relay assemblers had no reason to resist an upward trend in output or to pressure each other to prevent it (*28*). In short, the Bank Wiring Observation Room study showed what could *prevent* a rise in response rates. Since this hindrance was not present to impede the Relay Assembly Test Room operators, their rates could rise if other factors were favorable. The absence of the restraint may have been a necessary condition for the rates to go up, but it seems questionable that it was in itself a sufficient cause—although it has been suggested as such (*26*).

Still another contrast between the two groups deserves mention. It was relatively easy for the Bank Wiring Observation Room operators to adjust their response rates in order to produce only two units each day. They could observe their own performance and slow down their work on the second unit in the afternoon if necessary. They needed no records to tell them how many units they were completing per day. Each Relay Assembly Test Room operator, on the other hand, was producing dozens of similar or identical units per hour. Although she could judge output rate in an approximate fashion by self-observation, she still needed the half-hourly records from time to time as information feedback, and she needed the daily records to know her total output so she could compare it with other days.

Disposal of Myths

What light is shed by this review of the four documented Hawthorne studies?

In the principal experiment—the Relay Assembly Test Room (consisting of 24 periods, not 13, as generally described)—the overall response rate of the operators rose to an asymptotic level toward the end. However, it is erroneous to presume that the rate always rose when a condition changed, a presumption giving rise to the myth that *any* change resulted in faster work. On at least two occasions when the experimental conditions were changed, the rates declined. It is also erroneous to presume that the rate increased only *if* conditions changed. It tended to rise within conditions, an increase then reflected in differences in average rates between successive conditions. Finally, the overall increase failed to characterize all the groups studied at Hawthorne. In three studies,

output rate either failed to rise or dropped again later in the study.

The overall increase in output rate in the principal experiment made it difficult to demonstrate associations between changes in independent variables and changes in the dependent variable. However, there is some evidence, although not as much as would be desirable, that introducing rest pauses did raise the output rate. There is even some evidence, still weaker, that shorter working hours similarly influenced the rate. It is injudicious to state flatly that none of the independent variables had any demonstrable effect, although this has been widely assumed.

Using a time series design for the Relay Assembly Test Room experiment, the investigators properly reintroduced earlier states of the planned independent variables. The evidence they got was weak because differences were confounded by the overall increase in response rate. Rates of output dropped when there were no rest pauses, or when hours of work were longer, but they did not drop to earlier levels. Presumably they failed to do so because an irreversible change had occurred: the operators had acquired increased skill in assembling relays. In time series designs, it is advisable to make sure that a response rate is steady before changing experimental conditions; such designs are often called steady state designs (and are inappropriate in studying a process of change itself, such as acquisition of a skill). Experimenters must either wait until the rate levels off, or they must find and remove whatever is causing the rate to rise. The Hawthorne investigators were more remiss, technically, in doing neither than in using a time series design in the first place.

In the principal experiment, two-fifths of the subjects were changed at a critical point, thus making it impossible to compare averages for all five subjects between earlier and later experimental periods. The replacements started at much higher rates than those they replaced. Differences between individuals were noteworthy.

The complex relay assembling task permitted a considerable increase in production rate by speeding up manipulation movements; presumably the operators could also develop and vary procedures—changing either the assembling operations or nonproductive activities (*29*). The operators could adjust their own rates at will and did so for various reasons (*30*). The relatively low starting rate made it possible for the rate to rise by a considerable amount before it reached an apparent maximum (presumably caused by the counteraction of effort), where it fluctuated for more than 17 months. Although the increase in productivity has sometimes been viewed as dramatic, substantial increases in output rate have been found in other investigations (*31*).

Within-group influences were evident among the relay assemblers, and these could have affected the individual rates. Similar patterns of rate changes within three pairs suggested some dyadic process, such as imitation. Mutual support or pressure was evident when one worker would compensate for the low rate or absence of another or admonish another to work faster (*30*). Within-group pressure to restrict productivity did not characterize this experiment as it did the Bank Wiring Observation Room study. The leadership effectiveness of one of the replacement girls was notable.

With a few exceptions (*3, 9, 23, 32, 33*), the new method of paying the girls in the principal experiment has received little emphasis, possibly because the production rate continued to rise while the new wage incentive remained. Further, experimental certainty was denied this variable because the investigators did not reinstate the previous payment method to see if the rate would revert to its earlier level. They did so in the fifth experiment—and the rate dropped; but only Roethlisberger and Dickson (*3*) have given this much heed. These authors also drew on the sixth experiment (mica splitters) in discussing the impact of the new payment method, although they declared that "there was absolutely no evidence in favor of the hypothesis that the continuous increase in output in the Relay Assembly Test Room during the first two years could be attributed to the wage incentive *alone* [italics added]" (*3*, p. 160). By approximating an individual piecework system, the small-group method of compensation met the widely held assumption that an individual will work faster if he or she gets more money for doing so. The available evidence about such incentive plans has been assembled (*23, 34*), and, although more research is felt to be needed (*35*) and data may be inconclusive (*36*) [if only because the installation of such plans has often been confounded with other changes (*23*)], March and Simon (*37*) have asserted the efficacy of individual piecework methods, and Whyte (*38*) has published persuasive case studies. In one pertinent investigation, productivity appeared to increase as the groups paid on a group piecework basis got smaller (*39*).

While this new look at Hawthorne has tried to rescue the reward factor from neglect, it has brought a new factor to light—information feedback. The workers in the Relay Assembly Test Room received knowledge of results. Subsequent performance was adjusted as a result of information received about prior performance. When the Hawthorne research was conducted, the importance of information feedback in changing perceptual-motor behavior was not as widely recognized as it is today, and it is hardly surprising that the investigators failed to take it into account. More recent research on the positive effects of knowledge of results in acquiring skills has been well documented (*40*). Although early work concentrated on an individual's positioning movements, with feedback about accuracy, productivity has not been neglected. For example, in an experiment by Gibbs and Brown (*41*), subjects copied pages from documents. During equivalent periods of time, their output was greater when they could see a counter showing how many pages they had copied than when they could not, if the subject had first performed his task without the counter (*42*). Although research on information feedback has been done in the laboratory rather than industry, such feedback has been incorporated into technical training programs in industry and the military.

Theories of Consequences

Both piecework wages and information feedback are consequences of performance. Much research in recent years has shown that organisms, both human and infrahuman, acquire, maintain, and lose behavior because of its consequences. What happens to the organism after a particular response determines the likelihood of the response's reoccurrence. With human beings, rats, and pigeons, the coupling of consequence with response in order to influence that likelihood is called reinforcement, and the systematic application of contingent reinforcement is called operant condition-

ing. Many investigators, however, wish to take into account the fact that human performers can verbalize, or "cognize," about the response-consequence contingency. Hence, some prefer to emphasize man's use of "information," or his "goal-setting," or the "incentive" he derives for a future response from the consequence of a prior one, or his "expectancy" that a particular response will have a particular consequence.

According to E. A. Locke (*40*), information feedback has both cueing and motivational effects. However, its motivational effect, at least on speed of responding, is a goal-setting one. The subject establishes a goal for himself as a result of observing his own accomplishment, perhaps in combination with situational indicators. He sets some higher level of response speed or output rate as an objective (*43*). (Another way to get the same effect is for the experimenter to tell the subject what rate he should reach.) According to this interpretation, both the entire manner in which the Relay Assembly Test Room experiment was organized and the expressions of company managers and the observer-supervisor would have made it clear to the subjects that they should try to increase their output rates. But even if the other demand characteristics of the experiment had not implied instructions to work faster, the frequent feedback of information about output rates would have done so. The girls kept setting higher goals of productivity because of knowledge of results. Their own remarks tell us they were setting goals (*19*).

By contrast, instrumentality theory (*36, 37, 44*), which has much in common with an incentive approach, emphasizes the contingency relationship between performance and wages in terms of the "valence" that wages have, the worker's "perceptions" of that relationship, and his "intentions." (These constructs, of course, require further definition.) Unlike goal-setting, with its stress on information feedback, instrumentality theory emphasizes financial reward, giving little or no heed to knowledge of results. In treating current "expectancy" as a "cognition," it has tended to neglect the effects of previous performance on subsequent performance, although at least one model "utilizes past learning experiences as a factor in determining expectancies about the future" with a reward-feedback loop (*33*, p. 39). Presumably at Hawthorne the additional money the relay assemblers knew they would receive and had received for more output per unit time had additional "valence" that led to increased "effort."

Operant Conditioning

Operant conditioning has been extended through "behavior modification" techniques into applied situations, but these have not included worker performance in industry, although such an extension has been suggested (*45*) and at least one experiment has compared operant conditioning with instrumentality theory (*46*). In placing its explanatory emphasis entirely on the effects of past reinforcement, operant conditioning disregards what may be going on inside the heads of organisms in a situation again containing a particular response-consequence contingency. Behavior is a function of past reinforcement. The Hawthorne operators assembled relays because they had been paid for doing so, and payment had functioned as what B. F. Skinner has called a generalized type of secondary (conditioned) reinforcement (*47*), making subsequent relay-assembling behavior more likely. Further, since more money followed faster assembling rates, the rate of responding was differentially reinforced to become progressively higher. Since higher rates got more reinforcement than lower rates, higher rates became more frequent (*48*). The operators' behavior was "shaped"—they differentiated their response rates upward (*49*).

But another aspect of operant conditioning is stimulus control. Discriminative stimuli associated with previous reinforced responses control the selection of subsequent responses and their characteristics. This is a major mechanism whereby past behavior determines present behavior. The discriminative function of a stimulus is informational. In the task of relay assembling, discriminative stimuli would signal which rate of responding would receive greater reinforcement (money). Although the operators undoubtedly could use such stored cues as the visual and kinesthetic feedback from their own prior operations—that is, from their earlier response rates—these were not enough in this kind of task. Accordingly, the operators checked the half-hourly recordings from the counters when they felt uncertain about their rates, and they were guided by the daily reports. The information feedback they got from these sources functioned as additional and essential discriminative stimuli for the rate of the behavior to be emitted (*50*). Presumably, the information feedback also functioned as conditioned reinforcement to make the higher response rates thus reinforced more likely in the future.

The operant conditioning interpretation of the response-consequence contingency (i) does not rely on mentalistic constructs that have to be elaborately defined—if they can be—in a cognitive approach involving expectancy, intention, and so forth (*51*); (ii) ties the Hawthorne research into a large and growing body of applied research in behavior modification; and (iii) couples the reward system (small-group piecework pay) and the information system (feedback from the recording of performance data) nicely together to explain why the output rate in the principal Hawthorne experiment kept going up.

Other Rationales

One of the extraneous variables put forth to explain the rising output rate has variously been called morale (*2*) and attitude (*52–54*). Many people believe that the happier a worker is in his job, the harder he will work. But "the available research suggests that there is very little relationship between job satisfaction and job performance" (*55*, p. 142), because "the conditions which determine a person's level of job satisfaction and his level of job performance are not identical" (*36*, p. 187; *56*). Reviews of research support these conclusions (*57*), and in general "there is a growing awareness among investigators that attitudes tend to be unrelated to overt behaviors" (*58*, p. 528).

Mayo implied that the relay assemblers worked faster and faster because they found themselves in a "new industrial milieu, a milieu in which their own self-determination and their social well-being ranked first and the work was incidental" (*9*, p. 73). But what is "milieu"? A global concept of this nature must be defined operationally in order to be useful either in manipulating experimental variables or in arranging an industrial situation. It is necessary to specify the behaviors and attributes of the work setting which generate a particular set of global per-

ceptions that then are called "climate" (*59*). Further, it remains to be demonstrated empirically that these affect production rates of workers on the job. "Milieu" may indeed influence their attitudes, and it may also affect job turnover and absenteeism (*60*), which have been shown to be associated with low job satisfaction, and low satisfaction is related to various aspects of the job (*36*). But one must be careful to distinguish between job attendance and job productivity (*37*); they have different determinants.

Landsberger (*22*) and Homans (*8*) stressed the girls' reaction to the new kind of supervision in the experiment room. Not only were they no longer under a foreman's stern control, but they could converse at work, they conferred with the superintendent, their views were solicited about the experiment, and they exercised some veto power. From surveys of the research literature (*36, 61, 62*), it is apparent that industrial supervision varies in leadership style (democratic versus autocratic), degree of autonomy, extent of "consideration," participation in decision-making, type of "initating structure," and origin of pace-setting. However, it seems difficult to draw general conclusions because of conflicting results, reliance on correlational techniques, and interactions with other variables such as nature of the work task and criterion of performance (*63*). If level of productivity has differed according to different methods of supervision, no almost continuous, long-term increase like that at Hawthorne has been reported. The change in supervision of the relay assemblers may well have been important, but only as a necessary condition, not as a sufficient cause (*64*).

Small groups characteristically evolve within-group processes of social influence through leadership, imitation, encouragement, admonition, social reinforcement, and cooperation. The Relay Assembly Test Room was no exception. It has been proposed that the rise in output was due to team work (*53*), cohesiveness (*13*), informal organization (*8, 54*), interpersonal relations (*23*), and social unity (*9*). But as has been pointed out before (*36*, p. 231), these factors also existed in the Bank Wiring Observation Room, where the workers kept their production constant at its previous level. Such factors could hardly be the exclusive causes of both positive and negative effects, although they may well have contributed to the extent of these effects (*65*). Clearly, mutual social influences against increasing the production rate had to be abandoned in the Relay Assembly Test Room for the progressive rate increases to occur, and they were replaced by mutual social influences that supported the rate increase; but the continuing increase cannot be attributed primarily to these influences.

Finally, it has also been suggested that the relay assemblers kept increasing their production rate simply because they knew they were in an experiment (*2, 8, 13, 66*). But just what is such awareness and how can it bring about such a profound effect? Although experimental settings may indeed produce results different from those in the real world, the important thing is to determine specific features so experimenters can exclude or minimize them. One such feature might be obtrusive measurement; another, payoffs for performance. If these should occur together to reinforce the experimental subjects and thereby alter their performance, as happened in the Relay Assembly Test Room, then the experimental arrangements might indeed confound the independent variables. This is precisely the lesson of Hawthorne for research design: Don't let subjects see the data or reward them according to their performance. But such precautions are not the same as keeping subjects "unaware" that they are in an experiment.

In many of these published speculations on Hawthorne, several confounding variables have been proposed jointly, with no attempt to allocate relative importance. The speculations have not cited experimental research demonstrating a proposed variable's effects on performance, especially on response rate. Hypothesizers have not felt obliged to explain how their favored variables could account for increases within experimental conditions, which they failed to interpret as the acquisition of skill. If they had interpreted them as such, they would have looked for reinforcements and discriminative stimuli—or at least for information feedback.

Conclusion

The Hawthorne effect in experimental research is the unwanted effect of the experimental operations themselves. Following the Hawthorne studies, various explanations have been proposed to account for rising rates of production. Although in the Relay Assembly Test Room experiment the experimental operations may have produced other extraneous variables, a reexamination based on new and neglected evidence has yielded a new interpretation. The new variable, made more plausible because research in other contexts has shown it to have similar effects, is a combination of information feedback and financial reward. It is an example of the control of behavior by its consequences. Although several approaches may be taken to explain the effects of response-consequence contingencies, I have favored operant conditioning because it seems to account for progressive increases in response rate—the Hawthorne phenomenon. Generalizing from the particular situation at Hawthorne, I would define the Hawthorne effect as the confounding that occurs if experimenters fail to realize how the consequences of subjects' performance affect what subjects do. But the Hawthorne effect need not be viewed solely as a problem in conducting experiments. The phenomenon that created it should be studied in its own right, as Sommer (*67*) suggested with a different phenomenon in mind. The study of response-consequence contingencies might well be extended to the examination of motivation in industrial workers.

References and Notes

1. F. J. Roethlisberger, personal communication.
2. For example, W. N. Dember and J. J. Jenkins, *General Psychology: Modeling Behavior and Experience* (Prentice-Hall, Englewood Cliffs, N.J., 1970), pp. 52–53.
3. F. J. Roethlisberger and W. J. Dickson, *Management and the Worker* (Harvard Univ. Press, Cambridge, Mass., 1939).
4. C. E. Snow, *Tech. Eng. News* (November 1927), p. 256.
5. By Max Howarth based on information from Homer Hibarger, who ran the experiments (W. J. Dickson, personal communication).
6. The investigations were sponsored by the National Research Council, but no manuscript was ever sent to NRC for publication, according to P. K. McClure, National Academy of Sciences archivist.
7. Roethlisberger and Dickson (*3*) covered only the first 13 periods, as did Homans (*8*). Mayo (*9*) showed data for 23 of the periods but discussed only the first 15. Whitehead (*10*) described periods 1 through 21 and referred to the remainder. Pennock (*11*) also described the experiment.
8. G. C. Homans, in *Readings in Social Psychology*, G. E. Swanson, T. M. Newcomb, E. L. Hartley, Eds. (Holt, New York, rev. ed., 1952), pp. 637–649.
9. E. Mayo, *The Human Problems of an Industrial Civilization* (Harvard University Graduate School of Business Administration, Boston, 1933).
10. T. N. Whitehead, *The Industrial Worker* (Harvard Univ. Press, Cambridge, Mass., 1938), vol. 1.
11. G. A. Pennock, *Pers. J.* **8**, 296 (1930).
12. A free lunch was another innovation of little significance.
13. An exception is M. Argyle, *Occup. Psychol.* **27**, 98 (1953).

14. Both were male.
15. The only variation was that in period 11 the operators did not work on Saturday mornings, but they still got paid for them; the reason was "never explicitly stated by the investigators" (*3*, p. 68), but apparently it was to avoid introducing a new factor, loss in earnings.
16. According to Homans, "Records of every worker were kept, and every six months there was a rate revision, the purpose of which was to make the hourly rates of the different workers correspond to the relative efficiency" (*8*, p. 643). Roethlisberger and Dickson (*3*, p. 14) wrote that "the company used what was called a 'bogey' system of individual rating. The bogey, which was set up for each operation, represented a level of performance which could be sustained by a skilled and efficient operator. Records were kept of each individual's performance, and efficiency was figured weekly, using the bogey as a basis of comparison. The supervisor used the bogey in this manner to keep records of individual progress and ability and to detect irregularities of performance." Although these authors wrote (p. 128) that "the individual's rating in terms of the bogey was used as a basis for determining her hourly rate of pay," they also asserted (p. 410) that the bogey was simply "something 'to shoot at' and was intended to serve in much the same way as a record does for an athlete. . . . Rating a bogey had none of the effects of reducing a piece rate or hourly rate."
17. Except that the employees now furnished their own lunch.
18. The documentary sources (*3*, *7–11*) do not discuss this proximity or say who took the readings.
19. Other examples: Period 3: "Operator 3: . . . 'I'm almost up to Operator 4, and I have a bigger relay' " (*3*, p. 37). Period 4: "The operators were shown their output curves, and the low and high points in the day were pointed out" (*3*, p. 40). "[The observer] . . . informed them of their earnings for the previous week . . ." (*3*, p. 42). "The observer called the attention of Operator 3 to the fact that her output was low yesterday. Operator 3 replied, 'What of it? That's nothing, but watch me tomorrow. I'll make up for it' " (*3*, p. 46). Period 5: "Output and its corollary, increased earnings, became the topics of the day. . . . When the operators were notified on September 13 of their earnings for the day before . . . Operator 2A [commented]: 'Gee! We made 80 per cent yesterday—today we ought to make 90 per cent' " (*3*, p. 47). The percentage was the amount by which the piecework value of the group's earnings exceeded the group's pooled guaranteed-hourly-wage earnings. Period 9: ". . . on March 31, 1928, the record has this entry: 'Operator 2 admonished Operators 3 and 4 for not working hard enough.' And again, on April 3, 1928, Operator 2 said: 'We have to make a high percentage today to make up for yesterday,' to which Operator 3 replied, 'I'm going to make more than you today'. . . . On the following day, when told of the high earnings for the day before . . ." (*3*, p. 63). "When the operators were told of their earnings for yesterday, Op. 2 remarked, 'Say, I'm going to quit.' This was brought about by the girls' reaching a high mark of 68.2 relays per hour" (*10*, p. 123). Period 13: "[The girls were] trying to beat their former output records. . . . Each girl was conscious of how much work she was doing. Frequent attempts were made by certain operators to break the record for a day's work . . . the observer told the operators what their percentage for the previous day had been . . ." (*3*, pp. 73–74).
20. D. A. Chipman, personal communication.
21. Even if the earlier payment method had been reinstated, irreversible changes could have prevented a return to earlier rates.
22. H. A. Landsberger, *Hawthorne Revisited: "Management and the Worker," Its Critics, and Developments in Human Relations in Industry* (Cornell University, Ithaca, N.Y., 1958).
23. M. S. Viteles, *Motivation and Morale in Industry* (Norton, New York, 1953).
24. Whitehead (*10*) showed output rates after period 13 but did not discuss them. In period 15, which had conditions like those in 13, 10, and 7, the average output rate rose *during* the period and averaged higher than the group rates in the comparison periods. From periods 17 to 22, there was no longer any marked upward trend. Whitehead also related output rates to errors (defective relays), temperature and humidity, seasons, vacations and holidays, illness, time of day, changes in type of relay, and resemblances between operators. To the extent that effects were found, none seemed to bear on the two independent variables, rest pauses and work duration. According to Pennock (*11*), records of how much the girls slept each night indicated that the more sleep each got the night before, the greater the output the next day.
25. An exception is R. M. Gagne and E. A. Fleishman, *Psychology and Human Performance* (Holt, New York, 1959).
26. W. J. Dickson, personal communication.
27. Overtime was eliminated at the start of period 4. After about 38 weeks of this period, the workers had to handle a new type of mica; also during this period, the mica splitting department was transferred to another Hawthorne unit, and it was rumored the mica work would be moved from the Hawthorne plant entirely. In period 5, because of the economic depression, work duration was reduced to 8 hours per day and Saturday work was eliminated.
28. Had circumstances induced them, presumably they could have stopped the overall rise; they did so at the beginning of period 12, when rest pauses were eliminated.
29. Operating procedures did vary between and within operators. Interfering or nonproductive activities, variable in extent, included chatting in pairs, laughing and joking, reading newspapers, eating candy, and visiting the drinking fountain. Other nonproductive time was "personal time," for trips to the lavatory, for example. When rest pauses were introduced, personal time was cut in half.
30. The observer's recordings contained some pertinent entries: Period 10: ". . . when Operator 2 was excused for the day, Operators 1 and 3 immediately assigned themselves the task of keeping up the group earnings while she was away" (*3*, p. 68). Period 13: "If one girl wished to slack off, another girl, generally her neighbor alongside, would agree to speed up. . . . Operator 2: '. . . in the other department we were working hard and others would be laying low on the job. In here, when some girl is sick we speed up and when I am sick the other girls speed up. . . .' Operator 2 quite frequently admonished one of the slower girls. . . . Operator 1: 'We had better stop razzing Operator 3 . . .' " (*3*, pp. 73–74).
31. E. T. Klemmer and G. R. Lockhead, *J. Appl. Psychol.* **46**, 401 (1962); H. F. Rothe and C. T. Nye, *ibid.* **42**, 182 (1958).
32. R. M. Gagne and E. A. Fleishman (*25*); N. R. F. Maier, *Psychology in Industry* (Houghton Mifflin, New York, 1955).
33. L. W. Porter and E. E. Lawler III, *Managerial Attitudes and Performance* (Irwin, Homewood, Ill., 1968).
34. J. Dale, *Management Methods* **16**, 38 (1959); A. A. Rath, *Pers. J.* **39**, 172 (1960).
35. R. L. Opsahl and M. D. Dunnette, *Psychol. Bull.* **66**, 94 (1966).
36. V. H. Vroom, *Work and Motivation* (Wiley, New York, 1964), p. 252.
37. J. G. March and H. A. Simon, *Organizations* (Wiley, New York, 1958).
38. W. F. Whyte, *Money and Motivation: An Analysis of Incentive in Industry* (Harper, New York, 1955).
39. R. Marriott, *Occup. Psychol.* **23**, 47 (1949).
40. J. Annett, *Feedback and Human Behavior* (Penguin, Baltimore, 1969); I. McD. Bilodeau, in *Acquisition of Skill*, E. A. Bilodeau, Ed. (Academic Press, New York, 1966), pp. 255–296; L. L. Cummings, D. P. Schwab, M. Rosen, *J. Appl. Psychol.* **55**, 526 (1971); R. M. Gagne and E. A. Fleishman (*25*); E. A. Locke, *Org. Behav. Hum. Perform.* **3**, 156 (1968); ——, N. Cartledge, J. Koeppel, *Psychol. Bull.* **70**, 474 (1968).
41. C. B. Gibbs and I. D. Brown, *Manager* (May 1944), p. 374.
42. I. D. Brown, *J. Appl. Psychol.* **50**, 118 (1966).
43. A. Chapanis [*ibid.* **48**, 263 (1964)] designed an experiment like that of Gibbs and Brown (*41*), but tried to keep his subjects from establishing performance goals; he got contrary results.
44. J. P. Campbell, M. D. Dunnette, E. E. Lawler III, K. E. Weick, Jr., *Managerial Behavior, Performance, and Effectiveness* (McGraw-Hill, New York, 1970); B. S. Georgopoulos, G. M. Mahoney, N. W. Jones, *J. Appl. Psychol.* **41**, 345 (1957); G. Graen, *ibid.* **53**, No. 2, part 2 (1969).
45. J. P. Campbell, in *Annual Review of Psychology*, P. H. Mussen and M. R. Rosenzweig, Eds. (Annual Reviews, Palo Alto, Calif., 1971), vol. 22, pp. 565–602; W. R. Nord, *Org. Behav. Hum. Perform.* **4**, 375 (1960); L. J. Peter, *The Peter Prescription: How To Be Creative, Confident, and Competent* (Morrow, New York, 1972); W. F. Whyte, *Psychol. Today* (April 1972), p. 67.
46. G. Yuki, K. N. Wexley, J. D. Seymore, *J. Appl. Psychol.* **56**, 19 (1972).
47. B. F. Skinner, *Science and Human Behavior* (Macmillan, New York, 1953).
48. Among others, W. Kintsch [*J. Comp. Physiol. Psychol.* **55**, 882 (1962)] showed that the greater the reward (or the longer the preceding food deprivation), the greater the asymptotic speed of running.
49. F. A. Logan [*Incentive* (Yale Univ. Press, New Haven, Conn., 1960)] suggested that increasingly faster running results from the differential effects of reinforcement; the faster a rat runs, the sooner it gets the food. J. M. Notterman and D. E. Mintz [*Dynamics of Response* (Wiley, New York, 1965)] differentially conditioned the force of rats' lever-pressing. H. M. Parsons [thesis, University of California, Los Angeles (1963)] shaped force, duration, and latency of button-pressing in humans. See also F. S. Keller, *Learning: Reinforcement Theory* (Random House, New York, 1969), ed. 2, pp. 39–47. It is also possible to view output rates and piecework payment as "fixed ratio" schedules of reinforcement, in which a certain number of responses must be emitted before the worker is reinforced. Such schedules result in high response rates.
50. Pigeons pecking a disk on a fixed ratio schedule increased their rates when a "counter"—a spot of light increasing in size—was placed in their compartment. See C. B. Ferster and M. C. Perrott, *Behavior Principles* (Appleton-Century-Crofts, New York, 1968), p. 350; and C. B. Ferster and B. F. Skinner, *Schedules of Reinforcement* (Appleton-Century-Crofts, New York, 1957), pp. 89–109.
51. Eventually a scientific analysis will have to account for the private events giving rise to cognitive constructs and will even have to exploit them—for example, the TOTE (test-operate-test-exit) concept of G. A. Miller, E. Galanter, and K. H. Pribram [*Plans and the Structure of Behavior* (Holt, New York, 1960)]. It must also incorporate such operationally definable processes as goal-setting, level of aspiration, and adaptation level.
52. E. Mayo quoted a Western Electric Company executive as attributing the rise in output rate mainly to "change in mental attitude" (*9*, p. 70), a view popularized by S. Chase (*53*), but also perpetuated in technical discussion—for example, by H. C. Smith (*54*, p. 353).
53. S. Chase, *Men at Work* (Harcourt, Brace, New York, 1945).
54. H. C. Smith, *Psychology of Industrial Behavior* (McGraw-Hill, New York, ed. 2, 1964).
55. N. W. Heimstra and A. L. McDonald, *Psychology and Contemporary Problems* (Brooks-Cole, Monterey, Calif., 1973).
56. Note also J. G. March and H. A. Simon (*37*, p. 48): "High morale is not a sufficient condition for high productivity, and does not necessarily lead to higher productivity than low morale."
57. A. H. Brayfield and W. H. Crockett, *Psychol. Bull.* **52**, 396 (1955); E. E. Lawler III, *Pers. Psychol.* **23**, 223 (1970); E. A. Locke, *Org. Behav. Hum. Perform.* **5**, 484 (1970).
58. M. Fishbein and I. Ajzen, in *Annual Review of Psychology*, P. H. Mussen and M. R. Rosenzweig, Eds. (Annual Reviews, Palo Alto, Calif., 1972), vol. 23, pp. 487–544.
59. B. Schneider and D. T. Hall, *J. Appl. Psychol.* **56**, 447 (1972).
60. "There has been a decrease in absences of about 80 per cent among the girls since entering the test room," E. Mayo (*9*, p. 70) quoted a company review as reporting. "Test room operators have had approximately one-third as many sick absences as the regular department during the last six months." The review further noted "increased eagerness to come to work in the morning."
61. A. K. Korman, *Pers. Psychol.* **19**, 349 (1966); R. P. Quinn and R. L. Kahn, in *Annual Review of Psychology*, P. R. Farnsworth, O. McNemar, Q. McNemar, Eds. (Annual Reviews, Palo Alto, Calif., 1967), vol. 18, pp. 437–466.
62. S. M. Sales, *Pers. Psychol.* **19**, 275 (1966).
63. Sales said that, on balance, studies of democratic versus autocratic supervisory style "show

no consistent superiority of one style over another in terms of productivity outcome" (*62*, p. 280). Quinn and Kahn wrote (*61*, p. 448): "A style of leadership which affects worker attitudes may have little bearing on productivity; likewise a style which affects productivity may have no effects on attitudes."

64. If the change in supervision in the Relay Assembly Test Room had not occurred, previous habit and custom in the plant might have carried over into the experiment, thereby inhibiting changes in rate, as they probably helped do in the Bank Wiring Observation Room.
65. See S. E. Seashore, *Group Cohesiveness in the Industrial Work Group* (University of Michigan, Institute for Social Research, Survey Research Center, Ann Arbor, 1954).
66. A. Chapanis, *Research Techniques in Human Engineering* (Johns Hopkins Press, Baltimore, 1959).
67. R. Sommer, *Psychol. Bull.* **70**, 592 (1968).
68. I am grateful to G. C. Homans, F. J. Roethlisberger, and W. J. Dickson, who helped with information when I began this investigation and read an earlier version of this article, although I do not wish to imply they agreed with my conclusions. To these principal expositors of the Hawthorne research let me say that hindsight is easy, but I hope it will be tolerated when reexamination is timely. I am especially indebted to Dickson for putting me in touch with Donald A. Chipman, and to Chipman for his first-hand evidence about the Relay Assembly Test Room. I am also indebted to Stanley Dodds, who first made me aware that I had never read the primary source material on Hawthorne. I gratefully acknowledge permission to reproduce Figs. 1 and 3 from the Division of Research, Harvard Business School, and Table 1 and Fig. 2 from the Harvard University Press and from F. J. Roethlisberger and W. J. Dickson.

NEWS AND COMMENT

U.S.-U.S.S.R. Exchange: Americans Split on Schizophrenia Program

The 20-month-old agreement between the United States and the Soviet Union to perform joint research on schizophrenia may be endangered because of growing doubts on the American side about the Soviet Union's motives in the agreement. Central to the doubts of the American psychiatrists involved with the exchange is their conviction that some Soviet psychiatrists deliberately misdiagnose political dissidents as mentally ill and confine them on orders from higher authorities seeking to quell the dissident movement in Russia.

Unlike the U.S.–U.S.S.R. accords establishing joint research efforts in cancer, environmental health, and heart disease, which have proceeded in a more or less straightforward fashion since they were signed during the rosy Moscow summit meeting in May 1972, the schizophrenia research agreement is still in the exploratory stage. Work protocols, which are detailed research plans, have been signed in the other fields—but none for schizophrenia has been signed by the Soviets. About a dozen U.S. researchers have visited the Soviet Union under the agreement, but no Russian researcher has come here.

Several factors are contributing to the psychiatrists' unease about the Soviet motives. The purpose of the agreements was to facilitate communications between the two sides. Instead, some of the Americans' proposals have generated only minimal replies, and some of their letters have seemed to disappear into Russia, drawing as much response as if they had been sent into outer space. The American psychiatrists who have been to Russia express great admiration and respect for the younger psychiatric researchers they have met; but the leaders of Soviet psychiatry, whom the recently exiled novelist Alexander Solzhenitsyn and others have accused of acting as organs of coercion against dissenters, are viewed as suspect. There is also some evidence that the Soviet authorities use the mental health exchanges for propaganda purposes to whitewash their psychiatric system. Finally, the Americans debate how much they have to learn, scientifically, about schizophrenia from the Russians, after all. Interviews with most of the government and academic psychiatrists who have been to Russia under the agreement, in discussing these doubts, indicated that they have sometimes considered pulling out.

Today's Soviet mental health system is cited as a model of efficient national health care delivery. Nonetheless, charges that Russian psychiatry is abused for political purposes—made under the czars—persist. The best known recent case was in 1970, when the prominent gerontologist Zhores A. Medvedev was forcibly taken from his home, committed to a mental hospital, called a schizophrenic, and then diagnosed by a panel of psychiatrists (including some who are leaders in today's exchange with the United States) as a psychopath. According to a book he subsequently wrote about the experience, only a worldwide protest campaign conducted by Zhores' twin brother, Roy Medvedev, succeeded in winning Zhores' release 3 weeks later.* Both before the Medvedev case and since then, charges with considerable documentation have been made that this practice persists.

One American psychiatrist who was associated with the exchange program while in Russia says, "I did not see such cases. . . . I think they exist. I'm sure they do. It's a case of where their system of classifying people [as mentally ill] fits hand in glove with their political needs." Another psychiatrist echoed, "I don't think any of us doubt that it's going on."

Negotiating the schizophrenia agreement for the United States is Bertram S. Brown, director of the National Institute of Mental Health (NIMH). Brown says he has privately discussed the charges of abuse of Soviet psychiatry with the Russians "in every setting" he has been in. "I received assurances it wasn't so and remained skeptical." Nonetheless, he explained, for the time being the Americans will pursue their part in the agreement. "Even if it turned out that we had little to learn and ended up contributing more than we were getting, the end product would be better. The critical mass of work done on these problems would have been increased." But Brown, like the psychiatric researchers under him at NIMH who have been to Russia, cites scenarios under which they would withdraw. "If, when they do send people over here, the Russians only send second-rate researchers, or people who are politically safe, that would be a reason to withdraw."

The idea for a mental health research exchange was piggybacked onto

* Z. Medvedev and R. Medvedev, *A Question of Madness: Repression by Psychiatry in the Soviet Union*. Copyright 1971. First published by Macmillan, London Ltd., in Great Britain and Alfred A. Knopf, Inc., in the United States. (Random House, Vintage Books, New York, 1973).