PSYCHOSOMATIC MEDICINE—VOL. II, NO. 2, APRIL, 1940

RESPIRATION AND PERSONALITY—A PRELIMINARY REPORT: PART I. DESCRIPTION OF THE CURVES*

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INTRODUCTION[1]

THIS STUDY of the influence of emotions —or more generally, of psychic factors —upon respiration, is a part of an investigation that has been conducted at the Chicago Institute for Psychoanalysis on the relationships between body functions and emotional tendencies (*14*).

A study of emotional influences on respiration was undertaken because it seemed logical and promising. With but few exceptions, scientific progress comes not from a blind search for correlations or from isolated descriptions of phenomena, but from planned research based upon logical expectation. We considered a correlation between respiration and emotion to be probable on the basis of the evidence from both common knowledge and scientific observation. Examples of everyday phenomena which illustrate this correlation are the panting in fear, rage, and sexual excitement, the sighs of relief or despair, and the respiratory involvement in weeping and laughing. The posture of a person's chest is commonly considered to be an index of his mental state. The scientific literature on respiration and emotion is extensive, and the reader is referred to the reviews by Dunbar (*4*) and by Wittkower (*25*). Römer (*20*) has claimed that he has been able to reach correct conclusions regarding an individual's personality, from studying his spirograms. There are numerous references to the unconscious significance of respiration in the psychoanalytic literature. Freud (*8*) pointed out emotional factors in Dora's "nervous asthma." He described the Wolf-man's use of inhalation to take in the Holy Spirit, and exhalation to be rid of evil spirits as well as to prevent identification with cripples (*9*). Jones (*15*) refers to the mythological concepts of impregnation through breath, and Roheim (*19*) collected ethnological material showing the magic concepts of primitives connected with the respiratory act. Fenichel (*6*) in a neurotic case observed the unconscious symbolic significance of the inspiratory act as a means of incorporating objects. He also referred to anal-sadistic fantasies of attacking (poisoning) by breath. Oberndorf (*17*) described a case in which sniffling was an equivalent of sucking. The relation of emotional tensions to respiratory disturbances, especially to asthma, has been observed by a large number of clinicians and psychoanalysts, particularly Weiss (*23*) and F. Deutsch (*3*). A cooperative study by the group of the Chicago Institute for Psychoanalysis will soon appear (*7*).

The immediate considerations which led to undertaking the present inves-

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[1] This section of the work is submitted before that dealing with psychological correlations because it takes months and years to accumulate sufficient psychological data adequately to test our findings (since an analyst undertakes so few new analyses each year) while, in the meantime, others may find useful the method of analysis of the curves herein described.

tigation resulted from the study of emotional factors in gastrointestinal disturbances (*2*). The present work is a direct outgrowth of that study. It offered the advantage over the gastrointestinal work, of the possibility of quantitatively recording the physiological function which is being correlated. This advantage is shared by studies of the influence of emotional factors upon blood pressure.

In the study of gastrointestinal disturbances, it was found that psychological tendencies are likely to influence those physiological functions which have the same vector quality[2] (*1*). Psychological tendencies, with an eliminating vector, influence physiological functions of eliminating, incorporating psychological tendencies influence incorporating physiological activities, and retentive wishes influence retentive activities. We now asked ourselves whether these same elementary psychological vector tendencies that could be brought into causal relationship with certain gastrointestinal disturbances, might not also have an influence upon the respiratory act. For in the respiratory function also, all three of these vectors may find expression: incorporating tendencies in the inspiratory act, eliminating tendencies in the expiratory act, and retentive in breath holding. It was obvious that the only way of testing out this working hypothesis was to find a reliable method by which the relative strength of psychological factors could be established in different personalities, and also to find a quantitative method for studying the respiratory act.

[2] The word *vector* was introduced by Alexander to express the direction in relation to the individual of impulses which are seen both psychologically and physiologically. These he groups as follows: 1) centripetal, intaking, or incorporative, 2) retentive, and 3) centrifugal or eliminative. Thus the investigator confronted by a mass of psychological and physiological data is able to distinguish certain similarities between the two, namely, the direction of the impulses.

Technique

To obtain the respiratory curves or spirograms we employ the standard technique used in making basal metabolic rate determinations. Our machine is the usual metabolism apparatus with the capacity increased to 6500 cc. so that the patient's vital capacity can be recorded at the end of the test. This makes it possible to calculate the absolute respiratory or chest level (*Fig. 1*). This concept of the "chest level" or, better, "respiratory level" is illustrated in *Fig. 1* and will be described later. The tests are given in the usual fashion with the patient as relaxed as possible. Two tests are given in one morning and repeated the following day. This procedure is repeated every one to three months. Since we found that the shape of the respiratory curves of a given individual was usually not markedly different under non-basal conditions, the later curves were sometimes done after a half hour's rest, but not on an entirely empty stomach. This technique for obtaining respiratory curves has been criticized by certain authors, particularly by Golla (*11*) who employs a much more refined technique. We have found that the curves obtained from approximately three-quarters of our subjects were relatively constant whether taken with mouthpiece or face mask, and usually even whether they were obtained under basal conditions or not. If the mouthpiece and mouth breathing influence the individual's respiration, the influence is constant and characteristic of that individual. That is, we record the different shapes of spirograms yielded by individuals in a constant standard experimental situation. All tests are done by the same technician in standard fashion. We have, therefore, found no reason to change the technique, which has the advantage of simplicity and standardization and makes it possible for us to compare our curves

with those obtained in various laboratories in the course of ordinary basal metabolic determinations. We also obtain curves with the kymograph running at three inches per minute in addition to those obtained at the usual rate of one inch per minute. Standing up may alter the curves. All of ours were obtained with the subject supine, according to the standard metabolism technique.

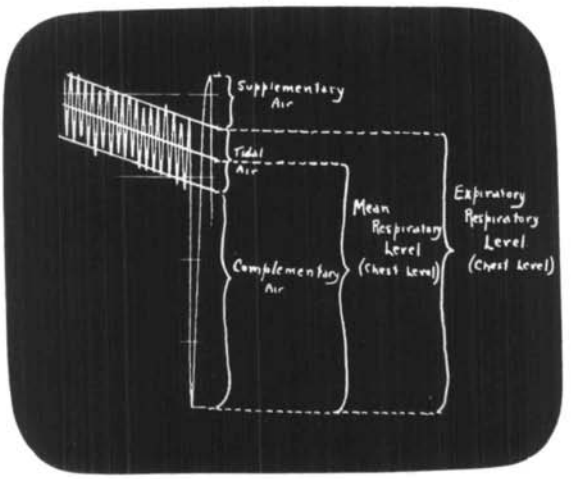

FIG. 1

In comparing spirograms with those obtained by other observers using the same method, the most important single point of standardization seems to be the amount of resistance of the apparatus to free respiration. As this resistance is increased, the spirogram shows widening of the tidal air and disappearance of important details of form, for example, the respiratory pause (rounding of the expiratory tips).

DESCRIPTION OF THE CURVES

In describing the spirograms or respiratory curves, we have directed our attention to certain characteristics: The rate and depth of respiration are of course commonly known and require no explanation.

The respiratory level (or chest level) has been mentioned by a few authors, *e.g.* Greene and Coggeshall (*12*), but has been little utilized in work in the respiratory field. The expiratory-respiratory level is that percentage of the total vital capacity which is composed of tidal air plus the complementary air. It may be thought of schematically as the level of the diaphragm during normal respiration. The mean respiratory level is this percentage measured from the middle of normal tidal respiration to total inspiration, in relation to the total vital capacity. Variations in respiratory level are seen in *Fig. 2*.

The rounding of the expiratory tips of the curves, shown in this figure, has been described in physiological text books as a normal respiratory pause. However, it occurred to an appreciable degree in only 40 per cent of our 75

male cases, and 30 per cent of our 76 female cases. Actually it is of course not really a pause but a slower reversal of direction. It is probably due to an increase of the expiratory stimulus relative to the inspiratory, so that the change from expiration to inspiration is prolonged.

In addition to these "chronic" phenomena of depth, rate, level of respiration, and rounded expiratory tips, certain characteristics so-called "spasmodic" phenomena also appear in the curves. These are slight hesitations in inspiration and expiration which we call respectively inspiratory and expiratory "hooks" and which are illustrated in *Fig. 3*. These "hooks" can be produced by swallowing, but they also appear at times when the subject does not swallow and is not aware of any hesitation in his breathing. Another feature which has been described in the literature in connection with sighing respiration, *e.g.* by Trumper (*22*) and others, consists in rather sudden, deep inspiratory "spikes" which may occur not as part of a sighing type of respiration but only occasionally and as a characteristic feature of certain curves. Sudden breath-holding is also seen on the curves in the form of flat or squared inspiratory or expiratory tips and may also occur at any place during respiration. These are also seen in *Fig. 3*. These phenomena are also encountered in laboratory animals. See for example illustrations in papers of Nicholson (*16*) and Smith (*21*).

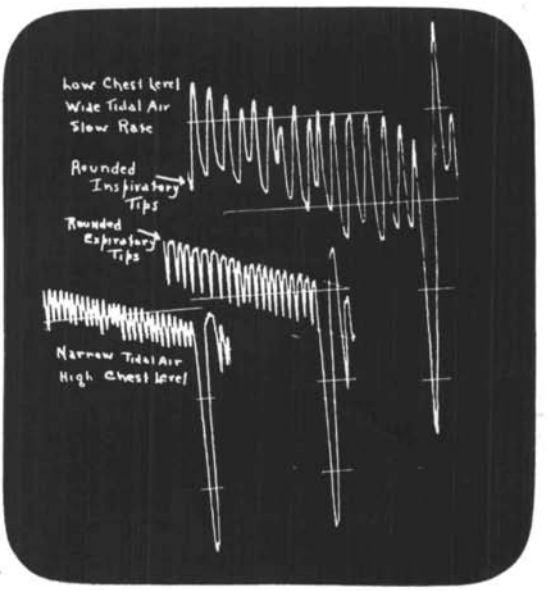

FIG. 2

We estimate the degree of rounding of expiratory tips as 0, 1 plus, 2 plus, and 3 plus. In doing this we take cog-

nizance of the prominence of rounding, *i.e.* whether the tips are markedly or only slightly rounded, and also of the percentage of the tips which show rounding at all (it is rare to find a curve in which every tip is rounded). The 0 is self-explanatory. We call 1 plus, those curves in which rounding is present but minimal, 3 plus, those in which it is excessive in reference to the average, and 2 plus, all the intermediates. The middle and lower curves of *Fig. 2* show 3 plus and 0 expiratory rounding respectively. We have used this very rough method of expressing the amount of rounding as a first approximation. With the kymograph at three inches per minute instead of at the usual rate of one inch per minute, spirograms are obtained which are more easily studied for certain features, particularly for rounded tips. *Fig. 4* shows two samples of different degrees of rounding. This may be represented mathematically by taking the ratio Inspiration/Expiration. Another method for more quantitative description of the rounding is by making a scale, as described by Finesinger (5).

In addition to the spirograms of the

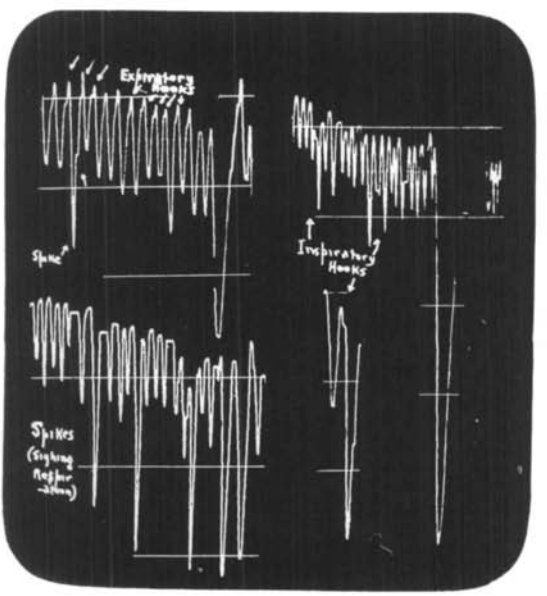

FIG. 3

Institute patients, curves were obtained from 16 patients with peptic ulcer referred by Dr. J. Meyer from the Michael Reese Out Patient Clinic. Fifty-two of the metabolism curves done at Billings Hospital were also studied. Dr. Read kindly gave us the opportunity to take curves on 46 paranoid and hebephrenic patients at the Elgin State Hospital. The total number of individuals whose curves we have studied is 265.

Average Figures[3]

Average figures for the original Institute groups of 30 men and 36 women patients are:

Males: Rate: 11.6, TA: 522.0 cc., TA per cent: 15.7, ERL per cent: 82.8, VC: 3593.1 cc. Rounding: 0—43.3 per cent, 1 plus—33.3 per cent, 2 plus—10.0 per cent, 3 plus—13.4 per cent. Expiratory Hooks: 0 and 1—76.7 per cent, 2 and over—23.3 per cent. Spikes: 0 and 1—93.3 per cent, 2 and over—6.7 per cent.

Females: Rate: 13.5, TA: 417 cc., TA per cent: 18.0, ERL per cent: 85.6, VC: 2453.4 cc. Rounding: 0—50.0 per cent, 1 plus—27.8 per cent, 2 plus—16.7 per cent, 3 plus—5.5 per cent. Expiratory Hooks: 0 and 1—69.5 per cent, 2 and over—30.5 per cent. Spikes: 0 and 1—86.1 per cent, 2 and over—13.9 per cent.

[3] A brief description of the technique, curves, and average findings has been published in: Proceedings of the American Physiological Society, Memphis, Tenn., 1937.

Individuality and Constancy of the Curves

Comparing a series of curves of one individual with a series obtained from another individual, two facts are immediately apparent. The first is that the curve is rather typical of the individual, like his handwriting. In other words, there are characteristic differences between the respiratory patterns of different individuals, just as their handwritings are different. In our series no two individuals have yielded identical respiratory patterns. The second fact is the constancy of any individual's respiratory tracing. In about three-quarters of the Institute cases, despite variations in details, the major features remained characteristic of the individual over long periods (at least three years, the duration of our studies). Those which showed considerable variability still retained recognizable individuality. Experiment showed imita-

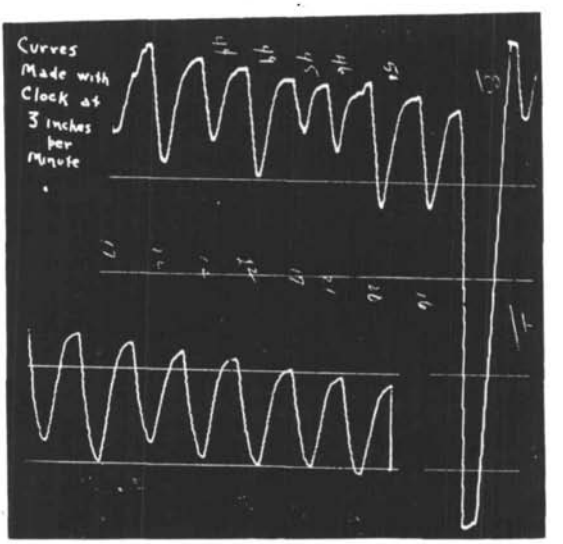

Fig. 4

tion of another's spirogram to be extremely difficult. These observations received striking corroboration in an article by Gesell (*10*) on the individuality of respiration in dogs. We found certain patients who regularly squeeze out all the supplementary air at each expiration, and who, when their vital capacity is taken, are unable to squeeze out more air from their lungs by special effort than they do during their regular breathing. That such different types exist even among animals was demonstrated by Gesell who by recording action currents from the respiratory muscles found that among 27 dogs, two did not use any expiratory muscles, and the remaining 25 showed varying degrees of active expiration. Details may vary though the general character of the curves remains constant.

Anthropometric Correlations

The question immediately arises: Is not this degree of individuality and constancy of the respiratory curve determined by physical structure, by the individual's body build or chest shape? To answer this question we made chest measurements on fifty patients in addition to the usual records of height, weight, age, temperature, pulse and blood pressure.

The following measurements were made using a thoracimeter with a spirit level: the circumference (axillary), antero-posterior axis, (from midline of sternum, level of third rib margin, in anterior axillary line), and transverse axis (axillary, on ribs). These were made with the chest relaxed, at full inspiration, and at full expiration. Ratios were then calculated of:

$$\frac{\text{transverse}}{\text{longitudinal}} \quad \frac{\text{antero-posterior}}{\text{longitudinal}}, \text{ and}$$

$$\frac{\text{transverse} \times \text{antero-posterior}}{\text{longitudinal}}$$

The product of the three axes was used as a very rough index of chest volume.

We then sought correlations between these measurements and combinations of these measurements and characteristics of the respiratory curves. But by the use of graphs, and then with the expert statistical treatment of the data by Mr. Harrison and Mr. Jaffe, we were unable to establish any significant correlations, with but one possible exception. Our negative findings, of course, do not prove that such correlations with the physique do not exist, but if they do we have not as yet been able to establish them. The one correlation which occurred with sufficient frequency to be of possible significance was the rather high incidence of rounding of expiratory tips in women with small chests of relatively short length, and with a low degree of longitudinal expansion.

The absence of correlation between style of breathing and physique is probably because the respiratory movements are controlled by a complicated and delicate balance between opposing innervations, inspiratory and expiratory (*18*). This sensitively balanced nervous control could be expected to determine the pattern far more than the body structure.

Where certain types of thoracic pathology exist we would expect to find some reflection in the spirogram. For example a patient with barrel chest showed a very high respiratory level, due probably to the inflexibility of his chest interfering with further expiration.

Respiratory Efficiency

In the Institute group the *respiratory efficiencies* of different individuals varied from 8 to 32 liters of oxygen breathed for one liter absorbed.

Correlations with Symptoms

Relative to the averages of the entire group, 21 asthmatics (8 men, 13 women) showed slightly faster rates, and less rounding, hooks and spikes. The fewer rounded tips in the asthmatic patients may perhaps result partly or entirely from narrowness of the bronchial tubes since it is well known (*13*) that rather shallow, slow respiration with rounded tips changes when the subject breathes through a narrow tube, to deeper, more rapid respiration with gradual disappearance of the rounded tips. Thus rounding may be masked by other factors.

Spirograms of Psychotics

Through the kind cooperation of Dr. Read we obtained curves from 46 psychotic patients at the Elgin State Hospital. We are in no position to draw any conclusions from these and wish only to draw attention to the shallow breathing, to the low respiratory level and absence of rounded tips in most of the hebephrenic spirograms. (This is consistent, according to our interpretation of the curves, to be developed later, with their acceptance of dependence and passivity, *i.e.* tendencies of intaking vector). Their rapid and shallow breathing has been noted by various workers (*24*). Sudden breath-holding ("squares") of over fifteen seconds has appeared only in the records of psychotics or very severe neurotics, as well of course as in such cases as respiratory tics.

Psychological Correlations

Our evidence at present is suggestive of a correlation between intaking and eliminating tendencies which are observable in the mental life, and characteristics of the spirograms, particularly between a preponderance of eliminating over intaking tendencies and rounding of the expiratory tips. We have also tried "factoring" the records for all details associated with inspiration as opposed to those associated with expiration. For example, inspiratory spikes, inspiratory hooks, wide tidal air, rounded tips at inspiration, square tips or breath-holding at inspiration and low chest level, are apparently all connected with increased inspiratory tendencies in respiration; while shallow respiration, hooks interrupting inspiration, rounding of expiratory tips, square expiratory tips or breath-holding at expiration and high chest levels, probably result from a relative over-balance of inspiratory by expiratory forces. This work on correlations between psychologically observable trends in the individual, and features of his spirogram, is still in progress. The results are as yet only suggestive. We expect to report on them further in the near future.

Summary

A study has been undertaken of respiratory tracings with special references to psychological correlations. We use an ordinary metabolism apparatus, with very low resistance to respiration, and enlarged so as to be able to include the vital capacity on the same tracing. In describing the curves we consider rate, depth, respiratory level, rounding of tips, "hooks," "squares" (breath-holding) and "spikes." Averages for the Institute group are given. The tracings are quite individual and relatively constant in approximately 75 per cent of the cases. No correlations with chest shape were found. Respiratory efficiencies varied from 8 to 32 liters of oxygen breathed for one liter absorbed. Spirograms were obtained from small groups of asthmatics, hebephrenics and paranoids. A study of correlations between the records and the intaking and eliminating tendencies of the individual is now in progress.

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