Original Communications.

THE CORSET:

QUESTIONS OF PRESSURE AND DISPLACEMENT.*

BY ROBERT L. DICKINSON, M.D., BROOKLYN,
LECTURER ON OBSTETRICS, LONG ISLAND COLLEGE HOSPITAL.

RIDICULE, argument, and invective have been freely expended upon the artificial small waist since the days of Martial and Galen. Yet the habit of corset-wearing has received little systematic study, and men's opinions are widely at variance. We frequently meet with the statement that corset-wearing works great injury; we discover a catalogue of five-and-ninety different diseases and disorders due to tight lacing; we find Bouvier, who has written the elaborate and interesting history of this article of dress, vigorously asserting that "the modern corset, moderately tightened, is without appreciable influence on the health of the healthy woman"—and we encounter all shades of opinion between these extremes. But unsupported assertion is poor evidence, although a general impression must carry some weight. To obtain clear perceptions of the action of the corset, I have endeavored to measure the amount of pressure it exerts, to ascertain the distribution of the pressure, and to determine the displacements resulting therefrom, studying the subject with as little bias as possible, stating bald facts, and rarely expressing opinions.

First a few words as to past usages. In the day of the primitive man, writes Bouvier, as soon as men were sufficiently elevated above the beast to admire the forms of women, women began to shape themselves to an ideal. Homer's Juno wore a many-layered girdle. The Greek women raised up hanging breasts and bandaged in prominent abdomens. The fascia and strophinum of the Roman lady, that the later poets tell of, were accused of deforming a chest, or crowding in an abdomen, or bringing about a curvature as effectually as any tight lacing of our day. These were the bandages, numerous and variously stiffened, that Galen inveighed against. In the dark ages the accomplishment vanished from western Europe, not to reappear until the sixteenth century. Then came the day of the perfect flower of small waists, as they have not been known before or since. The old portraits excite our wonder with good cause. The "corps" or corset of Catherine de Medici and Elizabeth was a "terrible engine," a case or sheath of nearly solid metal, rigid and unyielding. "To make their forms thin as a Spaniard's," cried Montaigne, "what hell will not women suffer, strained and lashed (*quindées et cenglées*) to the very quick?" Deep excoriations resulted from this pressure, and sometimes, he says, death ensued, even as Ambroise Paré also testified, citing his sectio cadaveris on a patient who died from such cause, in whom the lower ribs rode over one another (*chevauxçaient*). Before the year 1600, iron, ivory, and wooden busks† are credited with many abortions and much pulmonary hæmorrhage.

Men wore corsets for a time. The next step was to begin at the cradle. In order to produce men and women of beautiful proportions and new forms one could not commence too early, and "any mother would have laid herself open to the charge of gross indifference to her children's welfare who neglected these early cares, reputed indispensable to any regular formation of body."

The French Revolution swept away the iron and bone cuirass and brought in its stead the comparatively pliable and yielding corset of our time. I find in the journals and current stories evidence that in the early part of this century tight lacing was far more prevalent than to-day. Women occasionally died in the harness. Goodman, of Boston, writing in 1829, speaks of a not unusual practice of wearing the corset at night, tightening it when lying down, and again in the morning on rising. He found servants wearing such busks as to prevent sufficient stooping or crouching to put the kettle on, or place it on any lower level than a bench.

Observations on Corset Pressure.—The first test applied was to determine the external pressure by the manometer.* The bent U-tube carries between its arms a sliding scale, graduated in both directions. All the tubing is practically inelastic. That near the bag and the bag itself are re-enforced with cloth so that it is entirely inelastic. The T-branch running downward permits the bag to be filled or emptied without disturbing the mercury. The whole apparatus is filled with water to the perfect exclusion of air; the mercury is poured in so as to displace the water, and the water in the long limb adjusted above the mercury to the same level as that in the horizontal bend opposite. The bag must contain just sufficient water to bring its sides parallel and about one fourth of an inch apart, so that we get four square inches of contact when it is held between two plane surfaces. When the bag is on the same level as the fluid in the tubes, the mercury columns exactly balance; the zero point of the scale is then adjusted to the top of the mercury; the bag is slipped beneath the corset, the instrument is so held that the bag and tops of the water columns are on the same level, the corset is closed, and the readings

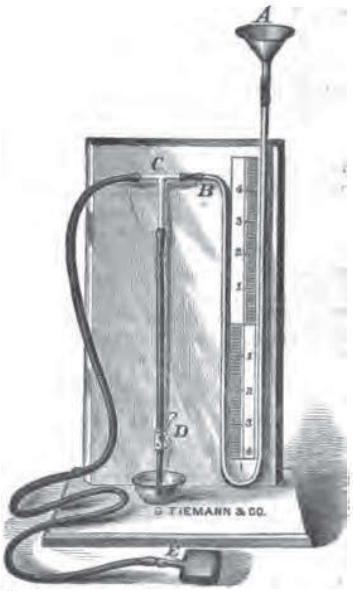


FIG. 1.—A manometer for testing the pressure. The bag, *E*, is slipped under the corset.

* Read before the Brooklyn Pathological Society, April 28, 1887.

† The "busk" is the front plate of the corset, which may be broad and of one solid piece, or divided and furnished with buttons as in the modern model.

* This apparatus is modified from those of Croom and Schatz.

are made. Care is taken, before every observation, to make sure that the levels are right, since a slight lowering of the manometer sends up the mercury column appreciably. Two inches of mercury displaced—*i. e.*, an inch on each side—will signify a pound of pressure to the four square inches of bag surface. To obtain the number of pounds pressure on one square inch of surface, the reading is divided by eight. The division tends to minimize any error.

Before recording these figures we may glance at other pressures in the body. I prefer to give the figures in pounds to the square inch, inasmuch as confusion arises from one observer speaking of an inch of mercury displacement when he refers to one column only, which would be named by another two inches displacement. If I speak of the mercury column I refer to the difference between the two levels.

The words "tight" and "loose" as applied to corsets need to be defined. They lack precision, but are necessary. We can not determine any limit of contraction in inches as the dividing line, since in cases cited farther on 1½ inch lessening of waist measure with one woman will cause more pressure and more distress than 5 inches in another. The guide must be the patient's sensations—when we can trust her testimony—and signs that are readily appreciated, such as the restricted respiration and movement, evident discomfort when the corset is first hooked, flushing of the face in a warm room, and the indentations in the skin after removal of the corset.

Appearance goes for nothing; a large bust and wide hips or shoulders give an impression of slenderness in the waist which may be entirely deceitful.

TABLE OF VARIOUS PRESSURES IN THE BODY AS COMPARED WITH CORSET PRESSURE.	Pounds pr'ssure to square inch, in decimals.	In eighths of a pound.
Blood-pressure, according to Foster, about	3·5	29
During labor pains, uterine force (Schatz)	1·6 to 5	..
" " " pressure in bladder, average (Croom)	1·88	15
" " " pressure in bladder, maximum.	3·2	25
Pressure in rectum in making straining efforts (Sobatz)	3	24
Expiratory force of lungs in man (Hutchinson)	2·50 to 3	16
Inspiratory or suction force (Hutchinson)	2	12
Pneumatic cabinet, increase of pressure bearable by patient	·5	4
" " decrease of pressure bearable by patient (Westbrook)	·5	4
Corset.—*1st, Tight Lacing.*		
The maximum pressure recorded was over the cartilages of the sixth and seventh ribs after a deep inspiration	1·625	13
Average pressure over sixth and seventh cartilages after full inspiration	1·25	10
Quiescent condition, over these cartilages	·625	5
" " mid-axillary line over sixth and seventh ribs	·5	4
" " epigastrium	·25	2
" " navel	·125	1
2d, Loose Corsets: 0·4 less than the preceding.		

The total pressure exerted by a given corset is obtained as follows: The areas of like pressures are chalked out on the corset by shifting the bag about under the corset, and testing at every move with the manometer. Knowing the number of square inches in an area and the number of pounds of pressure to the square inch, the pressure exerted on that area is found; adding the pressures in the various areas together gives us a total. This is by no means absolutely accurate, but furnishes a tangible figure. This estimate errs on the side of too low pressure by entirely leaving out of account the pressure below the crest of the ilium laterally and posteriorly.

I give two illustrative cases:

X. Y., habit of tight lacing; four children; lax abdominal wall; corset rather short. Circumference at waist without corset, 29 inches; circumference at waist over corset, 23½ inches; difference, 5½ inches. The total pressure of her corset is 65 pounds.

A. Z., vigorous, well built; one child eight years ago; has a strong abdominal wall; do not think she has worn tight corsets in some years, as she states; corset long. Waist measure without corsets, 27 inches; waist measure over loose corsets, 27 inches; no difference. Pressure, 40 pounds.

Same patient, waist measure without corsets, 27 inches; waist measure over fairly tight corsets, 25½ inches; difference, 1½ inch. Pressure, 73½ pounds.

The patient X. Y. had a flabby abdominal wall from frequent pregnancies and constant corset pressure. The patient A. Z. has a muscular abdominal wall; she says she works at home without corsets. These facts explain the seeming discrepancy that in the first case, with 5½ inches of constriction, the pressure is 65 pounds, while in the second, with 1½ inch, it is 73½ pounds. In one the parts readily yield; in the other firm resistance is encountered.

The least pressure I have estimated from a corset is 21 pounds; the greatest pressure I have found is 88 pounds.

A notable point in the use of the manometer is the distinct fall of the mercury during the first twenty seconds after the primary rise that occurs when the corset is hooked. This fall is followed by a slight rise or reaction before the mercury steadies itself. The main fall averages one inch (one eighth of a pound to the square inch), and must be due to the displacement of organs and the expulsion of blood from the liver and abdomen and of air from the lungs.

Within the half-minute that follows any exertion, such as rising, lying down, turning over, or straining, the mercury rises from ½ to 1½ inch, then gradually falls to its steady level. The reasons for these facts we may best study farther on in connection with the two cavities and their contained viscera.

On taking off a corset, one often observes that if the circumference of the waist is taken at once, and again a few minutes later, an increase of about an inch will have occurred.

Waist Measure.—Six inches difference between the circumference of the waist over the corset and the waist with the corset removed is the greatest difference I have measured. Five and a half and five I have met with once each. The least difference is in those cases where the measurement with and without is the same.

The average contraction of the 52 cases given in the table is 2½ inches. The maximum there is 4½ inches, the minimum 1 inch.

In the woman who wears no corsets the many layers of

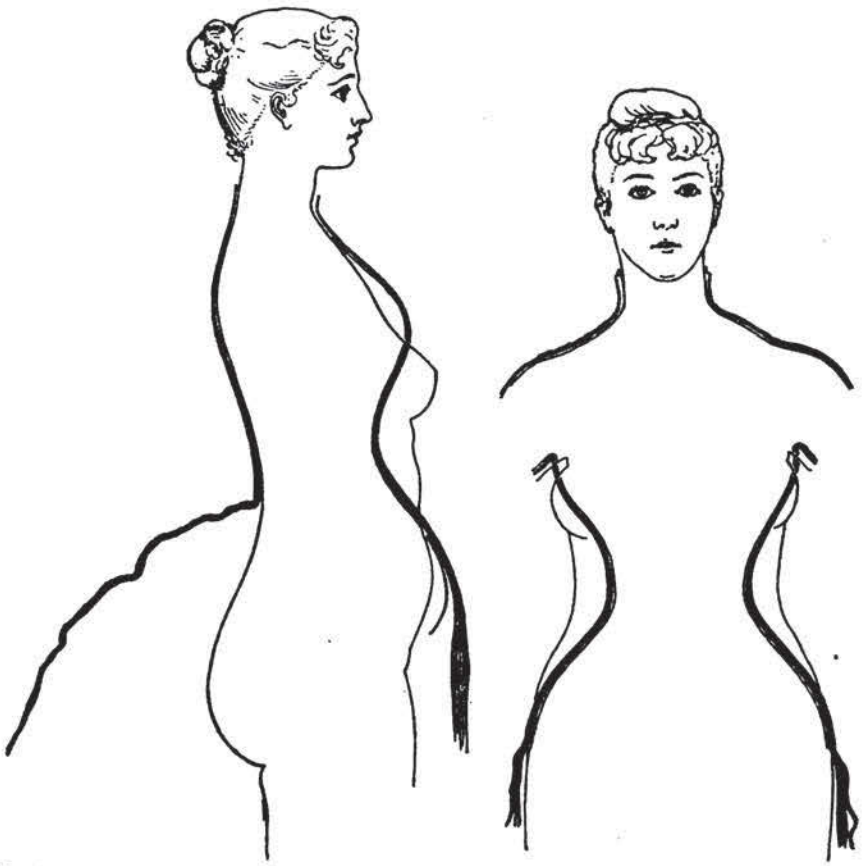
bands about the waist on which heavy skirts drag are sufficient to cause considerable constriction, as Dr. Mosher states.

We have seen that the amount of contraction at the waist bears no constant proportion to the amount of pressure exerted by a corset; we shall see that it bears no constant proportion to the diminution of vital capacity, excepting a very general one. The shape of the corset and the strength of its bones are other factors we must know, and the habit of the individual, the resisting or yielding nature of the abdominal walls, and the readiness with which organs are displaced, bear largely on the problem.

Effects of Pressure on the Thorax and Abdomen.—The "statical and dynamic mechanism of the thoracic and abdominal cavities" differ widely, as Walshe remarks. The chest may be said to be filled with air, the belly with water. Schatz connected a glass tube filled with water with the water-filled lower bowel, and found that the fluid in the tube was always on a level with the highest part of the abdominal cavity,* whether the patient stood, sat, or lay down, and whether much or little water was injected. The thoracic organs may readily accommodate themselves to a pressure that simply squeezes out some residual air; the abdominal viscera must be displaced. Accommodation can only be favored by expulsion of blood from the cavity and reabsorption of the gases distending the intestine. Let us first consider the cavity of the chest.

Effect on the Chest—Alteration in Shape.—My sketches of the changes in contour of the thorax and abdomen were made by accurately ascertaining the normal and the corset outline in the same subject by blackboard tracings or shadows thrown on manilla paper. These seemingly exaggerated proportions have been verified by caliper measurements, and I have been careful to undervalue rather than to overstate my fact. The organs were filled in from the frozen sections of Braun, Ruedinger, and Hart, from the valuable atlas and illustrated writings of Sibson, and from Frerichs.

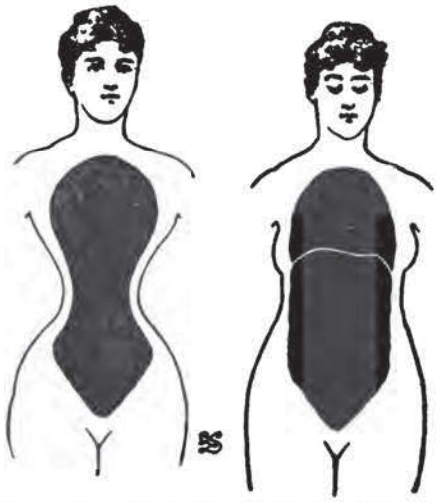
The thoracic cavity suffers less diminution in size and alteration in shape from corset-wearing than the abdominal. The principal constricting effect is exerted below the fifth rib. In the mid-axillary line the lung does not descend below the sixth rib in tranquil breathing. Below this level the "chest-wall" practically is the cover for the abdominal viscera, and it is on these that the corsets bear "The transverse diameter of the chest from the seventh rib to seventh rib, instead of being greater than that from fifth to fifth, as it is in males, is in females considerably less. The difference is greater or less according as the stays are worn more or less tight" (Sibson). Below the seventh rib the transverse diameter of the bony cage normally dwindles (Sappey), and from eleventh to eleventh is from one to one inch and a half less than the transverse diameter at the seventh or eighth. Bouvier measured one hundred and fifty subjects of both sexes and all ages, and found this relation constant. The corset increases this difference, and starts the downward taper at the fifth rib instead of at the seventh. Narrowing of the triangle between the cartilages of the lower ribs to a groove of the width of a finger is the extreme that Engel has sometimes seen. The inferior edge of the lung is therefore compressed, and its ability to distend the lower part of the pleural cavity seriously crippled. Compensation in part is effected by the tendency of the corset when firmly adjusted to raise the shoulders —which I find quite constant—forcing the upper lobes to do the breathing, as Sibson has proved, raising the thoracic, or five upper ribs, widening the interspaces (also a constant condition in the female), and in this way expanding the highest part of the conical thoracic cavity. This broadening above and constriction below are shown in Figs. 2, 4, 5, 6, and 7. Freer play of the apices in women who wear corsets would lead one to expect consolidation at these points to be relatively less frequent than in men, while affections at the base should be more commonly met with. An increased tendency to emphysema of the upper lobes might also be anticipated.



Figs. 2 and 3.—The heavy outline is the tracing of the corseted woman; the light, the same without corsets.

* With certain allowances easily explained.

One other change may be noted in some frozen sections, and is occasionally observed in examination of the chest—



Figs. 4 and 5.—The shape of the cavity when the corsets are tight; the same without corsets.

namely, a more marked inward curve in the lower part of the sternum than is usually found in men, whereby the an-

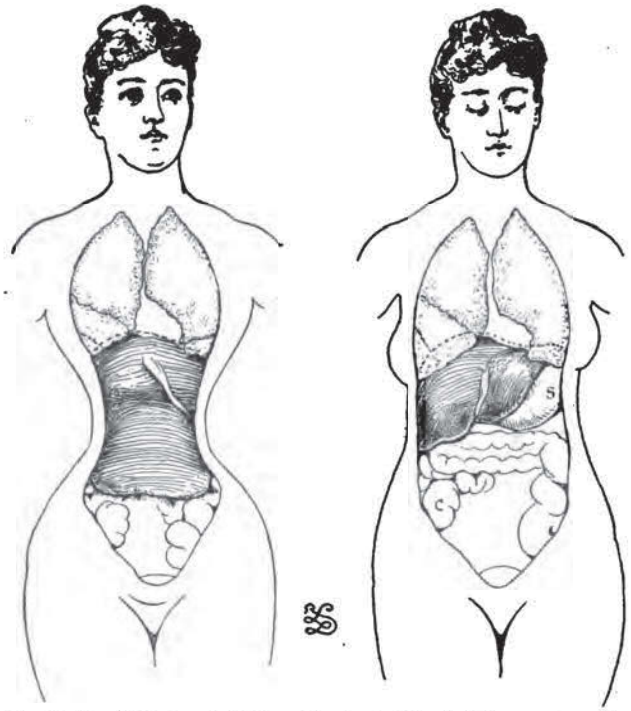


Fig. 6.—The displacement of viscera (tracings). Fig. 7.—The normal position of the organs (tracings).

tero-posterior diameter of the lower part of the chest is somewhat diminished.

The Thoracic Breathing of Women.—May the peculiar character of the respiration in women be attributed to the use of corsets? Two observers who are especially qualified to testify have stated the case so forcibly that I quote them entire. Sibson has made by far the most extended of all the studies of the mechanism of respiration. His painstaking accuracy is Teutonic. Walshe's opinion carries great weight. Sibson says:

"In the adult female the form of the chest and abdomen and the respiratory movements are often undoubtedly modified by tight lacing.

"The form of the chest and the respiratory movements do not differ perceptibly in girls and boys below the age of ten. Although the form of the chest remains nearly the same until the age of twelve, the abdominal movement is then somewhat less and the thoracic somewhat greater in girls than boys. At this age and earlier stays are worn, and though they do not compress the body materially, yet they restrain the free expansion of the lower ribs during free exercise. After the age of fourteen the form of the chest and the respiratory movements differ materially in females and males.

"When stays are on there is a great exaggeration in the thoracic movement, the second ribs moving forward from 0·06 to 0·2 inch, while, when the stays are off, they only move forward from 0·03 to 0·1 (that is, one half as far). On the other hand, the movements of the lower ribs are much more restrained when the stays are on—the abdominal movement then being 0·06 to 0·11 inch, whereas when they are off it is 0·08 to 0·2 inch. The difference at the waist when measured with the tape is very striking, the increased measure during extreme inspiration being 0·05 to 0·3 of an inch when they are on, and from 0·6 to 1·5 when off (from two to thirty times as much). I have found the circumference at the waist from one to two inches less when stays were worn than when they were taken off. . . .

"I think it probable that in females, even if they wore no stays, the thoracic respiration would be relatively greater and the diaphragmatic less than in man; but this is only surmise."

Delicate men, he says further, approximate to the female thoracic breathing, vigorous women to the male abdominal breathing, and long-distance runners have the least thoracic breathing of all men (in the quiescent condition).

The diaphragm would seem, therefore, to be a muscle capable of developing to meet increased demands as much as any other that the athlete strengthens.

Walshe objects to the supposition that the sexual difference is "preordained to meet the difficulties of pregnancy," as Boerhaave maintains, and asks whether ascitic females escape dyspnœa. "If we were forced," he says, "to the admission that the activity of infra-clavicular respiration-movement in the female is in the main designed by nature"—for which no cause can be detected—"and independent of extraneous influence, still I can not help thinking that the great excess of that movement and the limitation of thoracic play to the upper thorax in the civilized adult female are due in no small part to the unyielding cases interfering with inferior costal and phrenic action. The agricultural woman, who knows not stays, breathes more like a man than the town female. Besides, during sleep the conditions of pectoral and ventral action of the female are much less strikingly different from those in the male than in the waking state; the waist is relieved for a time from constriction. And, further, the male and female dog breathe almost exactly alike, as do the horse and mare; the action is abdominal and lower costal."

Dr. Mays, of Philadelphia, has recently studied the respiratory movements of Indian girls in the Lincoln Institution. They had always worn loose clothing. They ranged between ten and twenty years of age. Tracings from their costal and abdominal respiratory movements showed a very close analogy to those of the civilized male, and that, "so far as the Indian is concerned, the abdominal is the original type of respiration in both male and female, and that the costal type in the civilized female is developed through the constricting influence of dress around the abdomen. This is markedly shown in the greater prominence of the costal movements in those girls who were either one half or three fourths white, and who were hence dominated to a greater or less extent by the influence of civilized blood. . . . It is also evident that the costal type of respiration in the civilized female is not due to the influence of gestation."

"The expansion of the lower ribs," says Sibson, "is much more impeded than the descent of the diaphragm." By measurements to be detailed farther on, I find that, comparing full inspiration and complete expiration, the pelvic floor has a range of respiratory movement about one fourth less when the corsets are fairly tight than when they are off, whereas the lower ribs are so firmly incased as scarcely to expand at all. An old, broken, or very loose corset allows some inferior costal play; but, since this is the location of the ring of most marked constriction, even these cripple it considerably.

In what degree the total expansion is limited by this article of dress I have attempted to work out by studying the vital capacity * with and without corsets. To compare the expansion as measured ordinarily in men by passing a tape-measure about the chest is scarcely accurate when applied to women, since the soft parts vary in thickness, the mammæ being pushed upward by the corset and hanging down without it. The spirometer test is not open to any serious objection. I am greatly indebted to Dr. L. M. Hall for the labor involved in working out for me the following table:

Table showing the Effect of Corsets on Expansion in Fifty-two Women.

	Age.	WAIST.		Diff'r-ence.	VITAL CAPACITY.		Diff'r-ence.
		With.	Without.		With.	Without.	
Totals	1,100	1,245½	1,378¾	133¼	6,944	8,487	1,543
Averages	21·15	23·95	26·52	2·57	133·54	163·21	29·67
Extremes	13	21	23¼	1	80	100	5
	35	29	30¼	4¼	220	260	75

The average age is twenty-one. The average waist with the corset off measures 26½ inches. The average measurement over the corset is 24 inches, or 2½ inches less. The average vital capacity is 163 cubic inches without corsets. The average vital capacity, wearing the corset, is 30 cubic inches less.

The individuals upon whom these observations were made were servants of the best class. One half were native-born, the other half Irish (seventeen), German, Swedish, and English. Except on festive occasions, our immigrants have rarely worn corsets before reaching this country. All these are women who work, and, consequently, should have a more vigorous muscular system and better expansion than wealthier corset wearers, although Dr. Hall states that these servants lace tighter and are less healthy in appearance than the young ladies of the institution in which the observations were made. Among women who lead less active lives, while wearing closer-fitting street- and evening-dresses, it might be expected that the interference with expansion would be greater and of more serious import. In the cases given above the limitation is three sixteenths, or nearly *one fifth*.

We must remember always that our witnesses are inclined to perjury. The testimony is made to favor the corset, if possible, and to prove that it is not tight.

This table contains no instance of the eighteen- or sixteen-inch waists of which we hear accounts. The least measure is 21 inches. Nineteen inches and a half is the smallest circumference I have measured over the corset; the patient's normal measurement was 24 inches.

To ascertain whether there was any constant proportion or relation between the amount of constriction and the diminution of the vital capacity, I worked out a number of tables, which showed that the lessening of the circumference of the waist and the lessening of the vital capacity bore no constant relation. The problem is not so simple. Hutchinson found in his study of vital capacity (in 4,800 males) that the chest circumference bore no direct relation to the vital capacity. In a man of five feet one inch the vital capacity averages 175 cubic inches, and it varies eight cubic inches for each inch in height. I have not been able to find the average height of woman, or any statements relating to her vital capacity as compared with man's. From occasional measurements in gymnasiums, however, I know that it is less than man's in proportion to her height.

Effects of the Pressure on the Abdomen.—The abdominal cavity has far greater pressure and much more marked

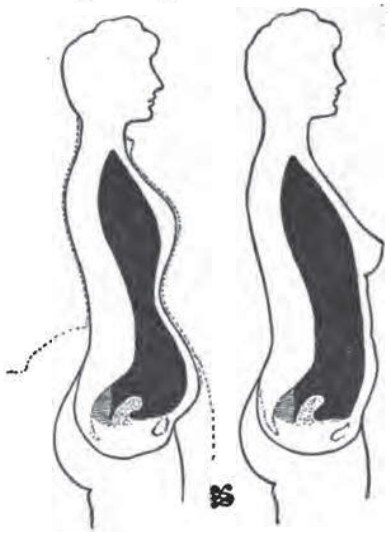


FIG. 9.—Antero-posterior section; shape of cavities with and without corsets.

alteration in shape to suffer than the thoracic. The change in its lateral walls has been considered in part, and figured in Figs. 3 and 4. In antero-posterior section (Fig. 9) the

* Hutchinson employed "vital capacity" to indicate the total number of cubic inches of air a man could expel from his lungs after the deepest inspiration.

deformity to which I would especially direct attention is the close approximation of the belly-wall to the spinal column, and the bulging of the hypogastrium. I have pictured no exaggerated instance, but give the tracing from a muscular young woman who has never been pregnant, with an abdominal wall of better vigor than common.

It will be seen that without the corset the breasts project beyond the abdomen, just as in a finely developed man

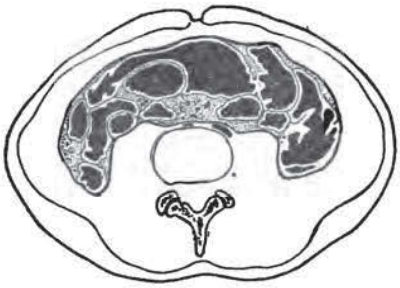


Fig. 10.—Section through umbilicus, least pressure; the black spaces indicate the empty intestines.

the pectorals first touch a perpendicular; whereas, when the corset has raised the "bust" and crowded the abdomen

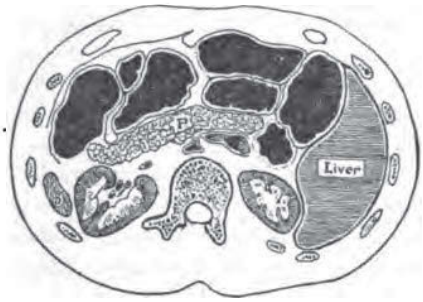


Fig. 11.—Through first lumbar vertebra, great pressure; the intestine (black) is the colon.

down and out, the supra-pubic wall becomes the most prominent and projecting part of the profile.

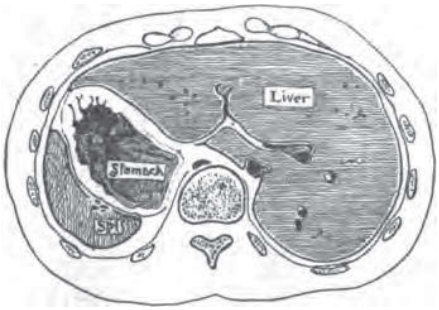


Fig. 12.—Section through epigastrium, area subjected to greatest pressure.

In transverse section the abdominal area at the level of the ensiform (Fig. 12) is normally about twice as great as that at the umbilicus (Fig. 10)—above, deep, roomy, bean-shaped; below, narrowing and contracting to scarcely more than a slit that curves about the broadened mass of the spinal column and psoas muscles.

The corset reverses this. The constriction binds closest the broadest part; the viscera are displaced downward; the lower umbilical region swells out; the greatest area must grow small, and the smallest enlarge.

The point of greatest pressure, we have seen, was over the cartilages. On both sides the liver will be pressed upon, and this at a point where it is covered by lung only during deep inspiration (Fig. 12). The lateral pressure will crowd liver and spleen toward the median line. The stomach will be pinched between its more solid neighbors, though both liver and spleen mold readily under pressure.

Two inches lower, the section (Fig. 11) contrasts strongly with the first. That showed nearly solid viscera; this presents large air-filled spaces. Here the pancreas, kidneys, and a small part of the liver only would receive stress, and they are protected by large air-cushions in front.

Again, two inches lower, the section greatly differs from the second. At this level, that of the navel, there are no viscera, except intestines distended with gas.

So that we find that (1) where the solid organs are, the greatest pressure comes; (2) where the hollow viscera lie, little pressure comes; (3) on organs that are comparatively fixed in their places, much stress is brought to bear; and (4) on organs freely movable, like the intestines, less direct displacing force is exerted.

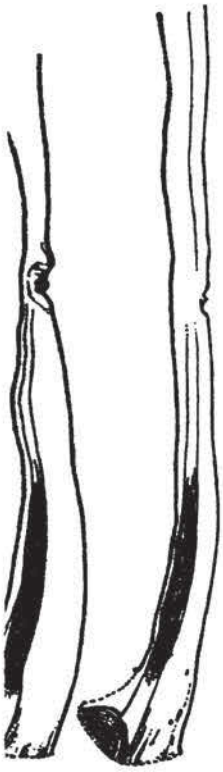
Effect of Pressure on the Abdominal Wall.—Long-continued compression of the wall of the abdomen in the epigastric and hypochondriac regions gradually brings about a thinning of its adipose layer.* Below the ring of constriction the fat accumulates. The woman who abhors "a stomach" yet adopts the most effective means of cultivating one. Flabby, old, or obese persons are especially prone to pile up panniculus adiposus below the navel. I have examined many stout young men in good condition, and have yet to find one in whom this tendency is evident. On the contrary, the fatty layer above the umbilicus is usually thicker than that below it. These men wear suspenders. In eleven healthy women below thirty who have been in the habit of wearing corsets (of varying degrees of tightness) the fat below the navel has always been found to be more than twice as thick as that above, while one to three is no uncommon ratio. That this is not normal is proved by the fact that in two teachers of gymnastics, measured for me by Dr. Mosher, the fatty layer was thicker above.

The two sections in Fig. 13 speak for themselves. The man and woman were each twenty-one years of age. The woman, Braun says, was well developed and finely formed, and her abdominal wall had never been stretched by a pregnant uterus, as one would suppose at first glance. Above the pubes the wall is four times as thick as it is higher up.

That the compression acts on muscle as well as fat is clear when we call to mind the contrast between the hard abdominal parietes of the average man and the lax belly of most women. How could the gynæcologist make his bimanual were it otherwise? Engel reports cases in which the peristaltic movements could be watched through walls thinned from tight lacing. Of course disuse and the less need of constantly balancing the body has much to do with the atrophy of the abdominal muscles of the female. If

* First mentioned, I believe, by Larget. "Thèse de Paris," 1827.

d his followers are right in attributing the exe head after it reaches the pelvic floor mainly to these muscles, we must credit the necessity for the use of forceps in a large number of cases to the practice of corset-wearing. It is worth noting that the figure given by Schatz as the intra-abdominal pressure not uncommon in man during straining efforts is nearly the same as the *maximum* pressure in the bladder during expulsive pains (Croom), which the uterine wall has some part in augmenting by its forward displacement.



F M

—Sections of the anterior ominal wall of the young fe- e (F) and male (M), showing uning from the pressure of sets. (Braun, frozen.)

Effect of the Pressure on the Pelvic Floor.—With the corsets snugly adjusted the general cavity of the trunk is cased in walls that are nearly unyielding at all places but two. The ribs, spinal column, and corset-bones sheathe the body as far down as the iliac crests laterally and the hypogastrium in front. Of the supra-pubic projection we have spoken. The other outlet for the pressure is the pelvic floor. It can be studied only in the horizontal position, either by tracings taken from the thin lead strip passed along the groove from symphysis to sacrum and rately molded, or by measurement of the projection of loor by the instrument of Dr. Frank P. Foster. This

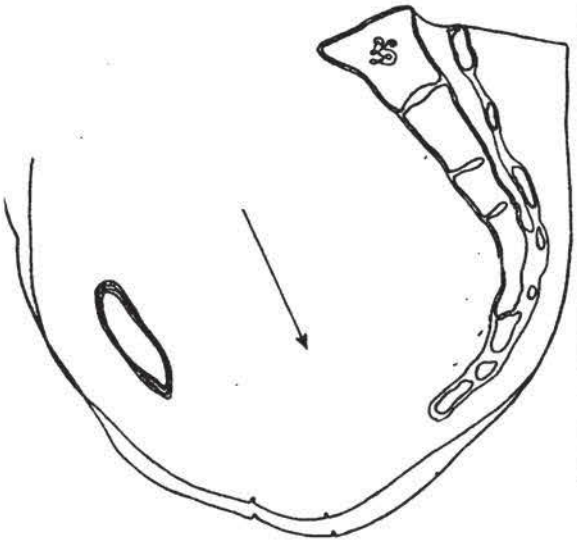


Fig. 14.—Tracing from the pelvic floor with and without corsets.

projection is measured on a perpendicular erected on a line joining the tip of the coccyx and the lower edge of the symphysis pubis. In Sims's position, while the patient "has her clothing on but the corset unbuttoned,"* the average projection was determined by Dr. Foster to be 2·5 cm., or one inch. I find that tight lacing increases this projection over one third—the average of 5 cases measured being 0·9 cm. (0·8 cm. minimum, 1·1 cm. maximum). This is twice as much depression as the deepest inspiration causes (0·4 cm.), and often is very close to the *extreme yielding* of the pelvic floor brought about by straining or bearing down, which is in the neighborhood of 4 centimetres, or one and a half inch plus.

I quote the figures in a well-marked case (Sims's position):

Pelvic Floor Projection.

	Without corsets.	With corsets tight.
Quiet	2·6 cm. (1 inch).	3·7 cm. (1½ in. scant).
Deep inspiration	3·2 cm. (1¼ inch).	4·1 cm. (1⅝ in.).
Straining	4·0 cm. (1½ plus).	4·8 cm. (1 11/16 in.).

I am inclined to believe that after a large number of cases have accumulated I can show that it is those women having roomy pelves, or pelves of less inclination than usual, whose pelvic floors sag most under pressure from above.

Effect on the Uterus.—This displacement of the pelvic floor and this abdominal pressure, acting on a cavity probably governed by the laws of fluid pressure, bear largely on the moot question of the importance of the corset as an agent in producing uterine disease and displacement. I think there can be no question that the uterus must descend with the structures about it. With a corset that is "quite tight," but not so tight as the patient "could bear it, as in a new dress or at a ball," this displacement is a third of an inch. The distance seems insignificant, and may only be considered of importance in view of the following facts:

1. That this is almost the deepest position to which the structures can be forced by straining down.

2. That the long-continued action of the depressing force is exerted during the period of growth.

3. In view of the results likely to ensue in case of weakened and enfeebled supports, in case of increased size and weight of the uterus—normally present during menstruation—and in case of incipient displacement. It naturally follows:

4. That this forcing downward is sufficient to render the uterine supports tense (be they ligament, "column," or pelvic surroundings in toto), and that in their taut condition any extra or added stress, like deep breathing, or exertion, or bending, might well be enough to each time slightly overstrain these stretched supports. Slowly and steadily as this force acts, yielding must in time occur.

In fact, Engel states that in every one of thirty autopsies in which evidences of tight lacing were found, prolapsus was present in some degree, except where adhesions had prevented it.

It might be noted that the ovarian veins, which usually are valveless, run upward into the region of greatest pressure to empty there, and that the hæmorrhoidal branches of

* Letter from Dr. Foster, April 8th.

the portal vein, which also lack valves, will suffer from the damming back that must be caused by the severe compression of the liver.

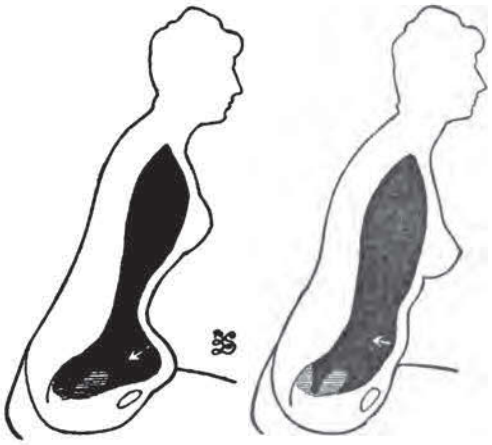


Fig. 15.—The effect of bending forward, when seated, with and without corsets.

The distortion of Fig. 15 does not need much commentary. The more this damsel bends, the greater the downward and backward push of her busk. Will not this account in part for the uterine troubles of women supposed to be due to many of their sedentary occupations, such as sewing-machine work? The man bending forward relaxes his abdominal wall and enormously lowers his intra-abdominal pressure by so doing (Schatz), but the corseted female, who writes or sews, produces the opposite effect. In some cases

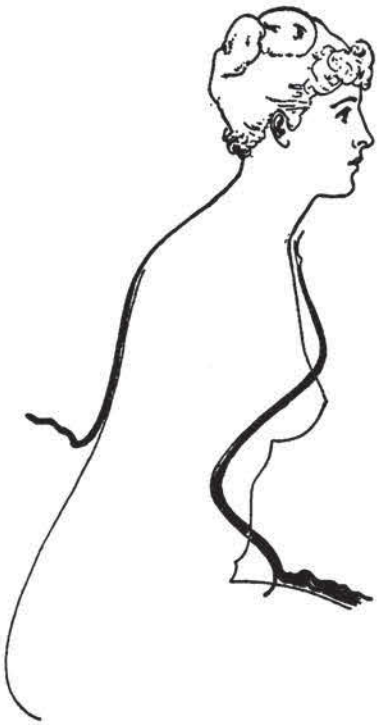


Fig. 16.—The heavy outline with corsets, the thin outline without corsets, the patient seated and bending forward.

I have recorded that in this position the pressure over the navel is about double that in the erect position, notwithstanding the abdominal relaxation. The exceptions to this augmentation of pressure are found where the corset-bones are broken or weakened and bend in into the epigastrium, and out again away from the pubes.

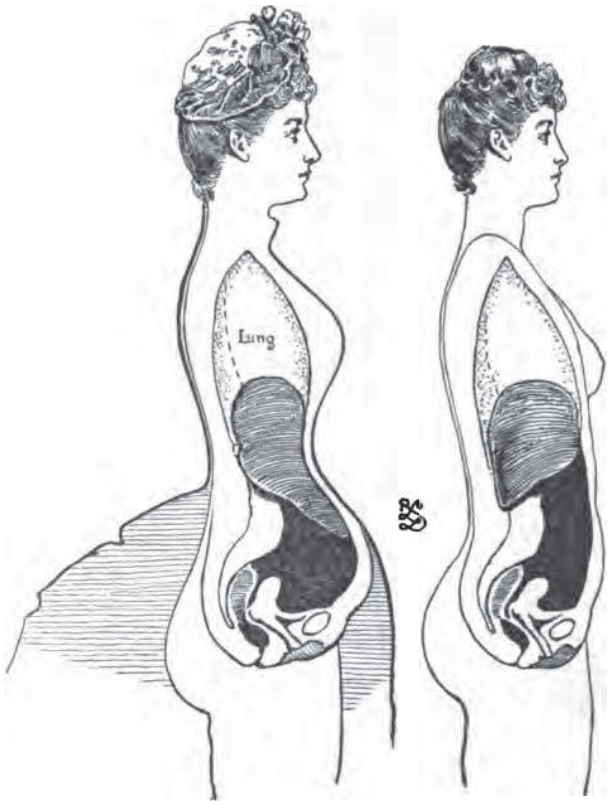


Fig. 17.—The tilting of the liver in certain cases of tight lacing. How the furrow of Fig. 6 is produced.

Effect of the Pressure on the Liver.—In viewing the transverse sections (Figs. 11 and 12) we saw that the zone of most marked pressure was over the liver. Laterally the ribs may be resistant enough to counteract this strain to a considerable extent; but over the cartilages, where the strongest compression of all is exerted, and in the epigastric region, the force must act with greater directness to push the anterior edge downward. Corbin, who has studied this displacement post mortem, states that, as this viscus is fixed behind, its anterior part drops, so that the surface, normally superior and horizontal, becomes anterior and vertical. . . . This effect is constant and is found in all, however loose the lacing may have been."

"On the face that is anterior there exists in most women a transverse depression or gully, more or less pronounced, so marked in some cases that the liver looks almost cut in two. The bottom of this groove is at times whitish in color from thickening of the peritonæum, capsule, and cellular tissue." In the discussion following the reading of this paper instances were cited to show that a habit of wearing about the waist a very tight cord or belt by men will cause like furrows, and that such fissures may result in more or less complete detachment of portions of the organ.

Indeed, Braun asserts that "it is open to proof that the form of the liver is not an independent one, but varies with the pressure and volume of neighboring organs; so that in

a normal condition it must possess a softness of structure which can be compared with fat and connective tissue, and which yields to the movements and change of position of the organs in contact with it."

I am the more inclined to believe this on account of the exceeding great blood supply of the organ. It is said to contain about one fourth the blood in the body. This peculiarity would allow of very marked fluctuations in size and in shape. The very distinct fall of the mercury column—one half to one inch and a half—twenty seconds after hooking the corset may be due in part to the liver emptying itself of blood.

The earlier corsets are worn, the more the liver would be affected, since it is proportionately much larger in the child than in the adult. Previous to puberty its weight may be as much as one thirtieth, or even one twentieth, of that of the entire body; in the adult it averages one fortieth.

"The practice of tight lacing," says Murchison, "may cause displacements and malformations of the liver which may simulate enlargement and which are of considerable importance in diagnosis. Tight lacing may act on the liver in three ways—according to the situation, the tightness, and the duration of the constricting cause.

"*a.* The liver may be displaced upward or downward according as the pressure is applied below or above. The precise situation where the pressure is applied will vary with the prevailing fashion of dress; but most commonly in this country the displacement is downward, and this may be to such an extent that the lower margin reaches the ilium, and the liver appears to fill up the whole of the right side and front of the abdomen." [Frerichs and other writers speak of this amount of change in location.]

"*b.* In consequence of lateral compression the liver may be elongated in its vertical diameter so that a larger portion of it is brought into apposition with the abdominal and thoracic walls. This is a very common result of tight lacing" (Figs. 6 and 17).

"*c.* When the pressure is exerted by a tight cord, it may produce deep fissures in the substance of the liver, as the result of which portions of the organ may be more or less detached, and may even be felt as movable tumors through the abdominal parietes."

"Apparent enlargements of the liver from tight lacing are far more common than is generally believed."

Though it is somewhat of a repetition, I must give an epitome of some thirty autopsies that Engel reports.

The lower edge of the liver, he says, is often displaced below the iliac crests. It is nothing unusual to find the fundus of the gall-bladder at the level of the crest. The furrow is often a hand wide. It rarely runs into the left lobe. The portion of hepatic tissue connecting the two parts is scarce over a finger's breadth. Not seldom scar-like bands and obliterated vessels of large caliber traverse the isthmus. Yet adhesions at this point are of the rarest occurrence.

Above the furrow, in the upper division of the right lobe, which is often much thinned from pressure, one sometimes encounters two deep indentations which run from behind obliquely or directly forward. In these the peritonæum and underlying hepatic tissue are normal.

The portion below the transverse groove may be thicker than that above. Its lower edge is blunt and rounded. Behind, it is strongly concave.

The ligamentum rotundum is displaced to the left. These changes are shown in Figs. 6, 7, and 17.

If, from the testimony of these five observers—Braun, Corbin, Engel, Frerichs, and Murchison—the extreme mobility of the liver has been proved, although we grant that these extremes result from tight lacing, are we not justified in believing that even a loosely adjusted corset must definitely displace so mobile an organ? The difference between the loosest corset and the tightest is less than might be imagined. I have not been able to double the pressure on requesting a patient to lace her loose corset to the utmost she could bear.

Engel found the *stomach* displaced in the following remarkable manner: It was shoved to the left. Its long axis, from a horizontal or oblique direction, was changed to a vertical, so that the lesser curvature ran down directly to the left of the spinal column. The pyloric end was depressed as far as the fourth lumbar vertebra. Constriction not unlike the liver-furrow was occasionally met with, but without pathological changes in the walls. The *pancreas* may be dragged down to a perpendicular position on the face of the vertebral column, reaching down to the promontory. These were extreme cases, of course.

A few of the most palpable changes brought about by corset pressure have thus been briefly described. There are many others as much more important as they are more subtle and difficult of proof, such as the disturbances of abdominal circulation, the effect on digestion, the limitation of exercise, and the slowly increasing action on the general health—questions of disturbed physiology which I hope to attack in the future. The necessary observations accumulate slowly. The conclusions reached at this time may be tabulated as follows:

Conclusions.

1. The maximum pressure at any one point was 1·625 pound to the square inch. This was during inspiration. The maximum in quiet breathing was over the sixth and seventh cartilages, and was 0·625 pound.

2. The estimated total pressure of the corset varies between thirty and eighty pounds—in a loose corset about thirty-five pounds, in a tight corset sixty-five pounds.

3. Within half a minute after hooking the corset such an adjustment occurs that a distinct fall in pressure results.

4. The circumference of the waist is no criterion of tightness. The difference between the waist measure with and without corsets gives no direct clew either to the number of pounds pressure or to the diminution in vital capacity. Relaxation and habit seem to affect these factors largely.

5. The capacity for expansion of the chest was found to be restricted one fifth when the corset was on.

6. The thoracic character of the breathing in women is largely due to corset-wearing.

7. The thoracic cavity is less affected by the corset than the abdominal.

8. The abdominal wall is thinned and weakened by the pressure of stays.

9. The liver suffers more direct pressure and is more frequently displaced than any other organ.

10. The pelvic floor is bulged downward by tight lacing one third of an inch (0·9 cm.).

Partial Bibliography.

Bouvier.—"Études historiques et médicales sur l'usage des corsets," "Bull. de l'acad. de méd. de Paris," 1852–'53, 355.

Bouvier et Bouland.—"Corset," "Dict. encycl. des sci. méd.," Paris, 1877.

Winslow.—"Mém. de l'acad. des sciences," 1741.

Soemmering.—"Ueber die Wirkungen d. Schnürbrüsten," 1793.

Engel.—"Wiener med. Wochenschrift," 1860 (529), "Die Wirkungen d. Schnürleibes."

Frerichs.—"Diseases of the Liver."

Mays.—"Therapeutic Gazette," May, 1887.

Murchison.—"Diseases of the Liver."

Walshe.—London "Med. Times and Gazette," 1829.

Sibson.—"Medical Anatomy," p. 962, "Med.-chir. Trans.," 1848.

Croom.—"The Bladder during Parturition."

Schatz.—"Archiv f. Gyn.," iii, 58; iv, 193.

Corbin.—"Des effets produits par les corsets sur le foie," "Gaz. méd. de Paris," 1830.

Foster.—"Am. Jour. of Obstet.," 1870.

Hutchinson, J.—"The Spirometer, the Stethoscope, and the Spring Balance," London, 1852.