which permit considerable distension of certain viscera, such as the pharynx and oesophagus, and of extreme distension of the veins in any condition involving severe physical effort or pathological venous congestion. In the thorax it is important to realize the extent of the fascial spaces in the posterior mediastinum and in relation to the lung roots, for those "dead spaces" not only allow room for expansion of engorged veins, but also determine the direction of expansion and spread of enlarged lymphatic glands and mediastinal tumours. The root of the left lung is almost encircled by the relatively resistant arch of the aorta, with a marked condensation in the surrounding connective tissue, whereas the root of the right lung is almost encircled by the dilatable vena azygos major and superior vena cava. The enlargement of glands, whether of the carinate group at the bifurcation of the trachea, or of those in the hilum of the right or left lung, is therefore directed towards the right side of the thorax. It is this tendency for the glands to enlarge on the right side which accounts for the phenomenon of right-sided paravertebral dullness, which has been so rightly emphasized by Riviere.³ Similarly the conduction of the whispered voice from the third to the fifth dorsal spine on the right side, as described by d'Espine, is another manifestation of the enlargement of the glands to the right. Opie has emphasized that the common calcium-bearing glandular lesions, distinguished by the deposition of calcium salts, are right-sided irrespective of the side in which the pulmonary and intrapulmonary glandular lesions occur. In fatal infantile disease the calcium-bearing mass of glands often extends as far as the right side of the bodies of the vertebrae. Opie⁴ has also stressed that the commonest demonstrable site of calcification, either radiographically or at necropsy, is in that lymph node which sits to the right of the trachea just above the bifurcation and above the arch of the vena azygos major.

Furthermore, the mediastinal pleura of the right side, above the level of the lung root, covers over a dead space extending from the superior vena cava anteriorly to the trachea and oesophagus medially, the right vagus lying somewhat freely therein. Enlarged glands in this area are frequently seen, and it is the perifibrosis thereof which so frequently leads to a strange "bruit de diable" over the right apex and neck, and renders the clinical signs in this area equivocal. The lowest gland in this space, just above the arch of the vena azygos major, is the one which most frequently displays a lesion, as mentioned above.

In order to obtain an instructive radiogram of the chest by freeing the right and left lung root from the shadow of the heart and great veins, it is essential to take the radiogram in that phase of respiration which fills the lungs with air and at the same time empties the heart of blood to the maximal extent. This is best accomplished by pinching the nostrils of the patient at the end of inspiration, either digitally or by a clip, and asking him to expire forcibly (Fig. 2), as in Valsalva's experiment. If the condition of the patient is such that Valsalva's experiment is dangerous, then the radiogram should be taken at the end of expiration, with forced expiration against obstruction, as in "bearing down" (Fig. 5). The information thus gained adds greatly to the value of the radiogram, and saves the expense of two or more oblique radiograms. Although with routine work with a Coolidge tube it is difficult to determine the size of those glands at the hilum which are enlarged but uncalcified, it should be noted that the gas tube often gives information of the degree of enlargement of both the calcified and uncalcified glands. This is well seen during and after an attack of measles or whooping-cough.

The repetition of the classical experiments of Valsalva and Müller, with the visible aid afforded by the x-ray screen and photography, clearly demonstrates the wide variation in appearance of the thorax in the same individual, and shows the need for further standardization in routine radiography of the chest. A given individual under different phases of respiration may simulate "cor bovinum" or "cor pendulosum." A brief study of the six radiograms presented indicates the need for the reconsideration of many of the terms used by the radiologist. Such terms as "dilated heart," "peribronchial

fibrosis," and "increased hilum shadows" may have to be abandoned.

With the growth of knowledge accurate diagnosis is coming to depend, even in greater measure than it has in the past, on considerations of exact anatomy and physiology applied with understanding to the concrete pathological problem presented by each individual patient.

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THE DEEP SUBMAXILLARY LYMPH GLANDS.

BY

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THE submaxillary lymph glands have for long been recognized as a chain of glands occupying the groove between the lower border of the mandible and the superficial surface of the submaxillary salivary gland. The number of glands is variably given, but three large ones are considered fairly constant. The biggest of these is usually in the centre of the chain, lying below the facial artery as it turns upwards on to the mandible. Other glands, placed one anteriorly and one posteriorly to this, complete the trio. There may be additional smaller glands in the chain, or one of the main three may be absent, particularly the posterior one. These glands lie beneath the superficial layer of deep cervical fascia, but outside the capsule of the submaxillary gland. Occasionally one finds mentioned deeper lymph glands beneath the salivary gland or inside its capsule, but no very exact account of observations on which such statements are based can readily be found.

It is well known that lymph glands are to be found actually embedded in the substance of the parotid gland. So intimate is the relationship between the two that, as Neisse demonstrated, salivary acini are to be found invading the interior of some of these intraparotid lymph glands. It does not yet seem to have been determined whether such interrelations exist between the submaxillary salivary and lymphatic glands, although Poirier and Cunéo make the positive statement that "contrary to what we have noticed in the case of the parotid, there do not appear to be any lymphatic glands included in the submaxillary salivary gland."

In 1903 von Brunn addressed himself to this problem. He specially wished to find out if metastases in the submaxillary salivary gland occurring in cases of labial or lingual carcinoma were to be explained by the presence of lymph glands inside the salivary gland. He gives, as surgeons will do, a black list of the standard anatomy textbooks of his time, which threw no light upon his problem. Even the voluminous Sappey failed him. Turning to more specialized works, mostly studies of the lymphatic drainage of the tongue, he found that although one or two investigators who had injected the lymphatics of this region did not find any deep submaxillary glands, others made passing mention of small glands inside the submaxillary gland capsule or even enveloped by the gland. But these last did not give satisfactory accounts of work on which their statements were based. Von Brunn, therefore, himself examined 61 submaxillary salivary glands, which he cut into sections 2 or 3 mm. thick. The sections were examined unstained, and his drawings at any rate are only naked-eye views. Of the glands, 15 were removed at operation from 9 cases of cancer of the lower lip or tongue. One or two of those contained carcinomatous nodules, but there were lymph glands in none. The remaining 46 submaxillary glands were taken from 23 subjects of all ages, dead of conditions other than disease of this region. In two only, from different individuals, were lymph glands found. In each case a single small gland was seen embedded in connective tissue prolonged into the submaxillary gland as

a thick, vertical septum from around the facial artery ascending in its groove on the posterior pole of the salivary gland. This position von Brunn characterized as clinically, though not anatomically, in the gland substance.

In 1907 Bartels, in a specially successful injection of the lymphatic vessels draining the tongue in a newborn child, noted a small lymph gland injected lying close to the submaxillary gland. He described it as lying under the capsule of the submaxillary gland, and designated it as a "parasubmaxillary" gland similar to those described by von Brunn. But he stated that it was separated from the salivary gland by the facial vein, which deeply furrowed the posterior end of the latter, and from his illustration it might quite well be regarded as a variant of a member of the superficial submaxillary chain which is sometimes found lying below the others on the anterior facial vein as it crosses the superficial aspect of the salivary gland. The little gland was connected by a lymphatic vessel with the middle gland of the main submaxillary chain, which had been injected from the lymphatics passing from the

FIG. 1.—Low power photomicrograph of deep submaxillary lymph gland. Note salivary tissue (on the right) invading hilum. The arrow points to the union of the duct draining the invading acini with another from the adjacent salivary lobule.

tongue. Bartels did not trace any direct lymphatic from the tongue to this parasubmaxillary gland; as it was unconnected with any other gland it was presumably injected by retrograde flow from the main submaxillary lymph gland just mentioned.

In his volume on the lymphatic system in Bardeleben's textbook, Bartels classifies the deep glands such as those described by von Brunn and himself, as well as those more casually mentioned by others under the capsule of the submaxillary gland, as "paramandibular" glands, distinct from the "mandibular" glands. (In this work Bartels corrects the term "submaxillary" of the B.N.A. into "mandibular.")

If, as is probable, these intracapsular lymph glands have only a localized drainage from the salivary gland itself, one cannot be certain of revealing them by injection methods. It seemed that the only sure way to determine their presence and exact relation to the salivary gland would be to examine microscopically stained serial sections of the latter. This was therefore done with four submaxillary salivary glands taken from young children.

Two of those showed no trace of any lymph gland directly related to them. In another a lymph gland of typical structure was found closely applied to its posterior pole beneath the salivary gland capsule. It was directly applied to the subjacent salivary acini which at the hilum of the lymph gland mingled with the issuing lymphatic vessels. Beyond this on one side a thin process of the lymph gland was prolonged for some distance under the capsule over a salivary lobule. In the remaining submaxillary gland a lymph gland was found under the capsule presenting still closer relations to the salivary tissue (Fig. 1). Salivary acini were seen invading the hilum of the lymph gland and lying scattered throughout its medulla, abutting on the cortex in places (Fig. 2). The invading acini were drained

by a duct which passed out of the lymph gland to join another draining the adjacent part of the submaxillary gland. This recalls the finding of Neisse in the parotid gland.

Thus there do exist, in some cases but not in all, deep submaxillary lymph glands inside the capsule of the submaxillary salivary gland, and directly related to the salivary acini. There seems to be no good reason for putting these deep glands, as Bartels has done, in a separate group from the more constantly found and more superficially placed submaxillary lymph glands. As in the case of the parotid salivary and lymph glands, all the lymph glands regionally associated with the submaxillary salivary gland may be classed together as submaxillary lymph glands. The main glands of this group, constantly present in varying numbers, are superficially situated under the deep fascia and external to the submaxillary gland capsule. Smaller and deeper members of the group are sometimes found embedded in the capsule (as those described by von Brunn) or inside the capsule in direct

FIG. 2.—Higher power view of another section of the same lymph gland as in Fig. 1, showing adjoining cortical zone (above) and medullary zone (below). The medullary portion is studded with salivary acini; a salivary ductule is running horizontally close to the lower edge of figure.

relation to the salivary tissue (as those I have now described).

The practical importance of the occasional presence of these deep lymph glands is twofold. Surgically, one cannot be sure of removing all submaxillary lymph glands present without removing also the salivary gland, as is the usual practice. Pathologically, these deep glands may be responsible for some occurrences of cancerous metastases in the salivary gland, and may be the real seat of the rare cases of apparently primary tuberculosis in the submaxillary gland.

In examining the sections used in this investigation one was struck by the comparative absence of lymphoid tissue round the submaxillary ducts. Where present at all this was confined to very small collections of lymphocytes around the smaller, but not the smallest, ducts. Rawitz has described masses of lymphoid tissue visible to the naked eye in stained sections of submaxillary gland in *Cercopithecus saheus*. These masses surrounded the smaller ducts and were devoid of all structural appearances resembling those of organized lymph glands. Rawitz claimed to have excluded the possibility of these masses being of inflammatory nature. No such appearances were seen in the human glands here studied.

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