

# HEBERDEN'S NODES: THE CLINICAL CHARACTERISTIC OF OSTEO-ARTHRITIS OF THE FINGERS

BY

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William Heberden was a prominent English physician of the eighteenth century whose name is associated with several diseases. His most important contribution was read at the Royal College of Physicians on July 21, 1768, and was printed in the *Medical Transactions* in 1772. This description of angina pectoris was of itself of sufficient importance to assure him of lasting fame. He later published a book in which he described enlargement of the fingers, a condition with which his name has since been uninterruptedly associated. The disease itself is benign and insignificant but references have been made to Heberden's nodes in nearly every study on arthritis which has appeared subsequently. His name has been so intimately associated with arthritis that he has become the patron saint of an organization devoted to the study of joint disease, an association called by his name, the Heberden Society. The present paper, devoted to this form of arthritis named for him, is a review and summary of studies on Heberden's nodes which have previously been reported in detail.

Heberden's original description is so short that it has been reprinted in full (Heberden, W., Jun., 1803): \*

“What are those little hard knobs, about the size of a small pea, which are frequently seen upon the fingers, particularly a little below the top, near the joint? They have no connexion with the gout, being found in persons who never had it; they continue for life; and being hardly ever attended with pain or disposed to become sore, are rather unsightly, than inconvenient though they must be some little hindrance to the free use of the fingers.”

Heberden obviously had no clear idea of their true nature, but he did dispel for all time the popular fallacy which had prevailed until then that these

enlargements were due to gout. Heberden's nodes have been called pathognomonic of, diagnostic of, typical examples of, the commonest manifestation of, and the most benign form of osteo-arthritis. It is now universally understood that they are a particular manifestation of this general disease. Because the lesions are so readily recognized with reasonable certainty, and because they occur with great frequency, the disease lends itself readily to clinical and statistical study. It was thought that important information could easily be obtained from study of this condition which might be applicable to other forms of osteo-arthritis.

## Incidence

The present author's interest was originally inspired by his seeing a man with enlarged fingers who stated that four sisters were similarly deformed. The significance of this observation obviously could not be ascertained unless the incidence of Heberden's nodes in the general population were known. It was to answer this particular question that a general survey of the population was undertaken (Stecher, 1940). The hands of nearly 7,000 individuals were examined. These were patients at Cleveland City Hospital and visitors to the dispensaries of two general hospitals as well as the residents in several homes for the aged. Since none of them had been selected because of the condition of their hands it was assumed that, so far as Heberden's nodes were concerned, this group was representative of random sampling of the general population. A separate card made for each individual examined bore the name, age, sex, race, and notes on the condition of the fingers. These cards were sorted into different classifications and were filed alphabetically. Duplication was thus avoided because the card was noted to be a duplicate and was discarded when a subject was seen a second time.

The condition of each deformed finger was described. Three degrees of deformity were recognized. The first was enlargement of the joint big enough to be obvious by inspection. Such enlargement was usually palpable as two round nodules or a dense solid bar across the

\* W. Heberden, Senior, died in 1801. The paper from which the quotation has been taken was published by his son, W. Heberden, Junior, in 1803.—Ed.

dorsum of the finger joint at the proximal end of the distal phalanx. As the enlargement became greater it was palpable at the sides of the joint and in extreme cases also on the palmar surface. A second degree of deformity included palmar flexion of the distal joint in addition to enlargement. In general this was seen only in fingers with more than minimal enlargement. The third degree of deformity consisted, in addition to enlargement and flexion, of a lateral deviation from the straight line of the distal phalanx. These designations were found to be reliable indications of three successive stages in the development of Heberden's nodes.

Observation and questioning soon revealed that Heberden's nodes arose in two different ways. Many men were seen even in the second decade of life with moderate enlargement of one finger. Even older men stated that such enlargements arose shortly after and in direct response to trauma. The injury had been painful enough to be vividly remembered and had been sustained in the majority of instances while playing baseball. The deformity had developed within the course of several months but had soon attained a condition which was constant. When once established there had been no progression of the process in the individual finger or extension of the disease to other fingers. Enlargements of the fingers due to injury came to be recognized as such and have been called traumatic Heberden's nodes.

Enlargements due to injuries were occasionally seen on women's fingers. Usually, however, women stated that enlargements of a single finger began gradually without reference to injury, that it slowly increased in size, and

that the process gradually extended to other fingers. These were called idiopathic Heberden's nodes to distinguish them from traumatic Heberden's nodes.

In the original survey involving observations on 6,913 individuals the incidence of idiopathic Heberden's nodes in white men rose gradually as age advanced from about 1 per cent. in the third and fourth decades to 18.2 per cent. in the ninth decade. This was different from the findings in white women. These showed 15.5, 24.7, and 29.4 per cent. in the seventh to the ninth decades. Because the apparent tendency to level off at a maximum incidence in old age seen in white females was entirely lacking in males, a resurvey was made of the condition in higher age groups (Stecher and Hersh, 1944). Based on observations in 151 white men and 184 white women of 70 years of age or over, the findings in women were about the same as in the original survey but the incidence was much lower in white men, only about 3 per cent. affected being found. Increased experience with the condition over a period of years served to eliminate more accurately the cases of traumatic nodes which had previously been included. Table 1 as now published is adapted from the original study. The revised figures for white males in the eight and ninth decades have been added in a footnote.

The study led to several general conclusions.

TABLE 1  
INCIDENCE OF TRAUMATIC AND IDIOPATHIC HEBERDEN'S NODES IN 6,913 SUBJECTS

Age group	20-29	30-39	40-49	50-59	60-69	70-79	80-89
<b>2,233 white men</b>							
Number examined .. ..	324	306	446	439	353	203	44
Traumatic nodes .. ..	7.1%	8.0%	9.2%	15.5%	23.2%	23.6%	11.4%
Idiopathic nodes .. ..	1.5%	1.0%	2.2%	3.6%	5.4%	8.4%*	18.2%*
<b>2,187 white women</b>							
Number examined .. ..	500	498	512	306	207	125	34
Traumatic nodes .. ..	0.2%	3.2%	5.7%	12.7%	12.1%	16.8%	5.9%
Idiopathic nodes .. ..	0.0%	0.4%	1.0%	2.6%	15.5%	24.7%	29.4%
<b>846 negro men</b>							
Number examined .. ..	184	249	191	131	75	16	
Traumatic nodes .. ..	8.2%	6.0%	10.0%	9.9%	14.7%	12.5%	
Idiopathic nodes .. ..	0.5%	0.4%	0.5%	3.1%	6.7%	6.3%	
<b>1,117 negro women</b>							
Number examined .. ..	330	346	255	124	48	12	2
Traumatic nodes .. ..	0.0%	2.3%	2.7%	4.0%	14.6%	16.7%	50.0%
Idiopathic nodes .. ..	0.0%	0.3%	0.0%	0.0%	2.1%	8.3%	0.0%
<b>530 white physicians</b>							
Number examined .. ..	104	147	165	73	34	7	
Traumatic nodes .. ..	1.9%	4.8%	4.8%	11.0%	11.8%	14.3%	
Idiopathic nodes .. ..	0.0%	0.0%	0.0%	2.7%	2.9%	0.0%	

\* In the resurvey, 4 of 129 men aged 70 to 79—or 3.2 per cent.—and 1 of 24 men aged 80 to 89—or 4.2 per cent.—had idiopathic Heberden's nodes.

The incidence of both types of Heberden's nodes tends to increase with age. The incidence of traumatic nodes is higher in men than in women, is higher in manual workers than in physicians, and is higher in white manual workers than in negroes. The differences in incidences of traumatic nodes between various groups of white people seem to depend upon difference in exposure of the fingers to trauma. The incidence of idiopathic nodes is universally low before the age of sixty, after which it increases very rapidly in white women. About one-third of white women become affected if they live long enough. The condition never attains a high proportion in men.

**Heredity**

When the incidence of Heberden's nodes for each sex and age group was known, the influence of heredity was investigated (Stecher, 1941). All the available relatives of 68 affected people were examined. Of 67 mothers of these people, 21 were said to have had Heberden's nodes. Of 129 sisters of affected women 33 were said to have Heberden's nodes. By classifying these relatives by age in decades and multiplying the number found in each decade with incidence for the particular classification, the number expected affected if this group had been normal was computed. It was found that the mothers of affected women were affected twice as often, and the sisters of the affected women were affected three times as often, as would have been expected in the normal population on the basis of chance alone. The details of these computations as they appeared in the original study are shown in Table 2.

In a control series chosen to resemble the study series as closely as possible in age and sex distribution, the sisters of non-arthritic index cases were found to be affected about as frequently as was

expected in the general population. The mothers were all reported to have been unaffected.

The probability of multiple family involvement was computed in three families. This was done by multiplying the incidences for all the affected brothers and sisters. It was found that such combinations were not to be expected by chance alone more often than once in 190, once in 4,500,000 and once in 10,000,000 families. Photographs of the available affected members in the last family are shown in Fig. 1. They consisted of a brother aged 59 and sisters aged 60, 58, and 50 years when seen. An additional affected sister died at the age of fifty-six. The probability for individual involvement, based on sex and age incidence as shown in Table 1, is 2.6 per cent., 2.6 per cent., 2.6 per cent., 3.6 per cent., and 15.5 per cent. The probability for such involvement combined in one family by chance alone is  $0.026 \times 0.026 \times 0.026 \times 0.036 \times 0.155$  equals 0.000000098 or one in about 10,000,000 times. It seemed reasonable to conclude that heredity played an important role in the production of these cases of Heberden's nodes in families.

**Mechanism of Inheritance**

The mechanism of inheritance was then investigated (Stecher and Hersh, 1944). Analysis was made of the pedigrees of 74 affected persons involving a total of 127 men and 215 women. Of the 215 women, 108, or one-half, were found to be affected, a proportion suggesting immediately that the trait was inherited as a simple dominant. In a simple dominant one parent is expected to be affected. In this series an affected parent, invariably the mother, was found in only 25 of the 74 families. In view of the rarity of the condition in men it was assumed that the trait though dominant in women might be recessive in men. The affected parent in some cases might be the apparently normal father. Since nearly

TABLE 2  
OCCURRENCE OF HEBERDEN'S NODES IN RELATIVES OF AFFECTED PERSONS: 68 FAMILIES

Age groups	Age incidence	In 67 mothers			In 129 sisters		
		Total mothers	Expected affected	Recorded affected	Total sisters	Expected affected	Recorded affected
20-29 .. ..	0.000	2	0.000	0	6	0.000	0
30-39 .. ..	0.004	4	0.016	0	16	0.064	1
40-49 .. ..	0.010	3	0.030	0	17	0.170	3
50-59 .. ..	0.026	9	0.234	0	39	1.014	10
60-69 .. ..	0.155	19	2.945	8	31	4.805	14
70-79 .. ..	0.347	16	3.952	9	11	2.717	2
80 .. ..	0.294	14	3.823	4	9	2.646	3
Totals ..		67	11.000	21	129	11.416	33

one-third of the population had been found to be heterozygous for Heberden's nodes, one-third of the fathers were expected to be genotypically normal in all families in addition to the obviously affected mothers.

In genetic studies on human material the attainment of Mendelian ratios is prevented by two particularly important factors, small family size and lack of penetrance. Correction for small family size by Hogben's method was applied to two different groups (Hogben, 1933). In one group of 29 families with known maternal involvement and suspected but unrecognized involvement in one third of the fathers, 53 of 95 daughters were observed affected. This compared favourably with the 54.9 expected affected with 1:1 ratio. In 35 families with apparently normal maternal inheritance and suspected paternal inheritance, 46 of 96 daughters were observed affected compared to 57.7 expected affected.

Correction for lack of penetrance was then made in the following manner. The age of onset of Heberden's nodes had been satisfactorily identified in 95 women. Of these 95 women the median age of onset was 48 years. At 54 years of age, three-quarters of these 95 women had developed Heberden's nodes. The family groups were sorted according to age. The incidence found between 30 and 48 years was doubled. The incidence found between 49 and 54 years was corrected by multiplying by four-thirds, and the incidence of those 55 or over was not altered. These corrections gave the number finally expected affected.

When these corrections had been made for small family size and for incomplete penetrance, the 29 families with observed maternal inheritance and suspected inheritance from one-third of the fathers as well, showed that 66 of 95 daughters, or 70 per cent., are finally expected affected. This is a ratio of over 2 affected to 1 normal rather than the usual 1:1 ratio expected in a simple dominant with one parent affected. The unrecognized involvement in one-third of the fathers accounts for the excessive ratio. In 35 families without suspected maternal inheritance and with paternal inheritance alone 53.6 of 96 daughters, or 56 per cent. are finally expected affected. This approximates very closely the theoretical 1:1 ratio expected with one affected parent.

On the assumption that the trait is recessive in men, sons would be affected only in response to double inheritance. With such a heritage a 3:1 ratio would be expected among daughters. In 4 such families of known double inheritance, as indicated by the presence of affected sons, 8 of 11 daughters were affected—a close approximation to theoretical expectancy in such circumstances.

In spite of an apparent lack of agreement with Mendelian ratios the analysis showed, on the basis of numerical tests, that these data support the hypothesis of a genetic mechanism of idiopathic Heberden's nodes involving a single autosomal gene, sex-influenced, dominant in females and recessive in males.

### Osteo-arthritis of Other Joints

The association of Heberden's nodes with osteo-arthritis in other parts of the body was investigated (Stecher, 1946b). Of 94 women with Heberden's nodes, 12 were found to have osteo-arthritis of other joints. In 11 patients this involved the knee, in one patient the hip. It was never severe enough to incapacitate the patient, but it did cause inconvenience and discomfort in most instances. Deformity was not marked, but limitation of motion and crepitus was noted in all the affected knees. Several of the patients had a decided limp but none required a cane or crutch. All took acetylsalicylic acid and many had resorted at one time or another to physical therapy, particularly diathermy and massage. Aside from the 12 patients mentioned above, 19 others complained of arthritis or rheumatism. They had transient stiffness, occasional soreness, and questionable swelling, and had used acetylsalicylic acid for relief. Their symptoms were intermittent, but no objective signs warranting a diagnosis of osteo-arthritis were found. These patients were not investigated as a routine by x-ray examination.

All knees were tested for crepitus by palpation during motion. Crepitus was noted in 34, or 36 per cent., of the cases. The patient was often unaware of this condition. Crepitus cannot be considered normal. It does not of itself warrant a diagnosis of osteo-arthritis. It is not necessarily a forerunner of future joint disability. The significance of crepitus in these cases is not clear.

In the control series of about 109 women of about the same age distribution, 3 had osteo-arthritis of a knee diagnosed because of pain, limitation of motion, and deformity. Crepitus was noted in only 25, or 23 per cent., of the women, compared to 36 per cent. in the study series.

The marked preponderance of osteo-arthritis in patients with Heberden's nodes compared with those in the control series is apparent. The occurrence of joint disease with objective evidence of pathologic change explaining the symptoms in 12 of 94 affected women compared with 2 of 109 control cases is obviously too great to be explained by chance alone.

### Relation to Hypertension

A study of blood pressure was made comparing 112 women with Heberden's nodes and 92 women of the control series (Stecher, 1946a). Both groups were of similar age distribution. The control series was otherwise chosen at random. It was found that average blood pressures for each age decade were about the same in each group. After combining both series into one group, no significant association between Heberden's nodes and hypertension could be demonstrated. The coefficient of

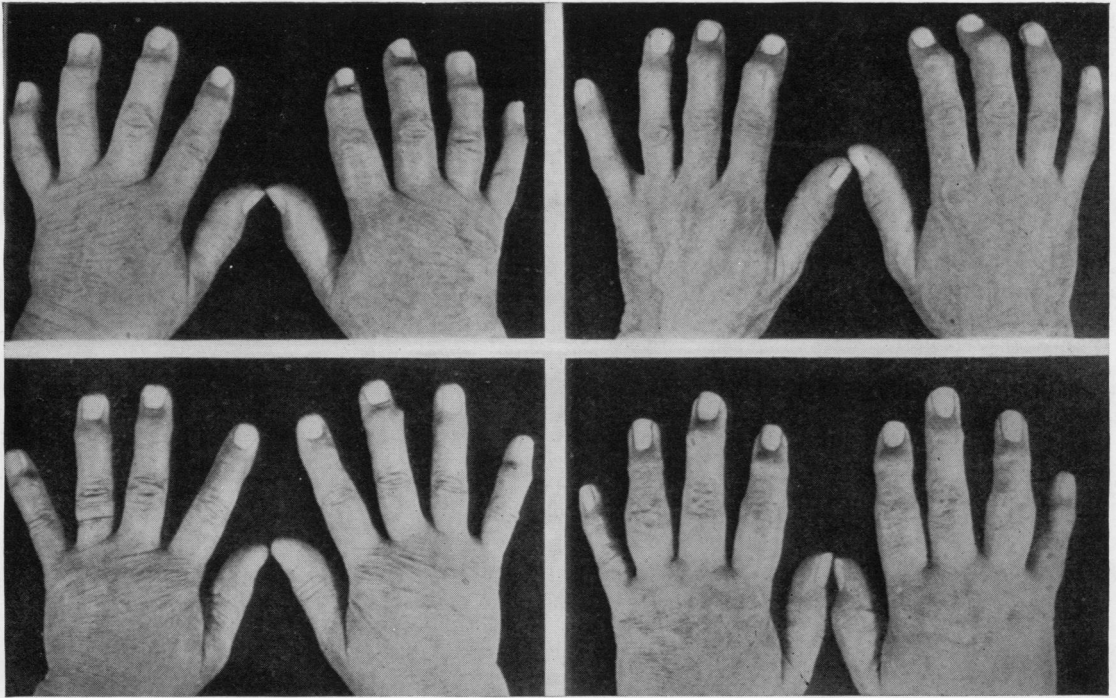


FIG. 1.—The hands of the four living of the five members of one family affected with Heberden's nodes.



FIG. 2.—Right hand of a 51-year-old woman, showing marked variation in the degree of development of Heberden's nodes.

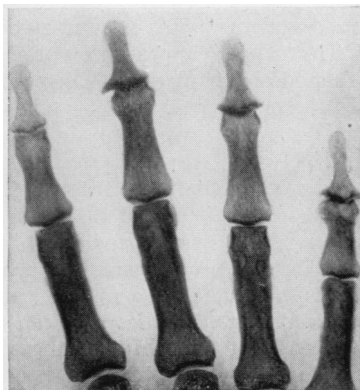


FIG. 3.—Antero-posterior radiographs show normal index and ring fingers and deformity of the middle finger. The little finger shows mushrooming of the ends of the bones, with spur formation.

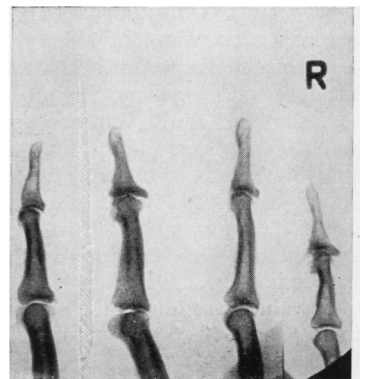


FIG. 4.—Lateral radiographs of the fingers shown in Fig. 2 show marked spur formation arising from the attachments of the flexor and extensor tendons.

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association was  $+0.25$ . In a further series of 82 women with hypertension Heberden's nodes were found only as frequently as was to be expected in the normal population. It was concluded from these findings and from a review of the literature that Heberden's nodes or osteo-arthritis of the fingers does not differ in relation to hypertension from osteo-arthritis of other joints.

### Relation to Obesity

The relationship between Heberden's nodes and obesity was then studied, the same control being relied upon (Stecher, 1946a). No association was found in this series between Heberden's nodes and obesity, despite the fact that a strong positive association has been noted in the literature between osteo-arthritis and obesity. In this respect, Heberden's nodes differ widely from osteo-arthritis of other joints.

### Relation to the Menopause

The relationship of the menopause to Heberden's nodes was then investigated (Stecher and Beard, unpublished). Ninety-nine women with Heberden's nodes who had passed the menopause were studied. The age of onset of Heberden's nodes in these women ranged from 33 to 65 years. The median age was 49.8 years and the average age was  $46.8 \pm 6.8$  years. The age of the menopause in these women averaged  $48.6 \pm 5.25$  years. This was about the same as found for the control group in which the menopause averaged  $48.9 \pm 4.9$  years and quite similar to the results in the study of 1,000 English women in which the menopause averaged  $46.4 \pm 3.9$  years (Report of the Sub-committee of the Council of Medical Women's Federation, 1933). The menopausal history in women with Heberden's nodes did not appear to be unusual. The average difference in age between the menopause and the onset of Heberden's nodes was  $4.92 \pm 4.0$  years. The menopause preceded the onset of Heberden's nodes in 44 instances and the menopause followed the onset in 45 instances. Both events occurred in the same year in 10 instances. If the time interval between these two events is computed in the same direction, assigning a positive value when the menopause precedes the onset and a negative value when it follows the onset of Heberden's nodes, the average difference is  $+0.72 \pm 6.3$  years. A wide dispersion of these values was found, the menopause occurring from 15 years before to 20 years after the onset of Heberden's nodes.

Despite the wide dispersion, close association of the menopause to the onset was observed in many cases. In 10 instances both events occurred in the same year. In 44 instances, or in nearly half the women, the menopause and the onset of Heberden's nodes occurred within 3 years of each other. The

correlation coefficient for the two events was found to be  $+0.46 \pm 0.08$  a figure which is significant. Although the correlation coefficient is significant and nearly half the patients with Heberden's nodes noted a close relationship in point of time between these two events, the rest of the patients noted no such association.

Only one-third of all women are genotypically susceptible to Heberden's nodes. The majority of them, therefore, will escape the defect under every circumstance. Of the susceptible one-third who get Heberden's nodes, only about one-half develop the disease in association with the menopause.

The mechanism by which the menopause influences the production of Heberden's nodes is not clear, but two possibilities are discussed. The menopause stimulates the production of gonadotropic hormone and probably also of growth-promoting hormone by the pituitary gland. Animal experiments are reviewed showing that growth-promoting hormone in mature animals stimulates proliferation of joint cartilage and adjacent bone. This occurs in acromegaly, but the pathological changes in acromegaly are quite different from those in Heberden's nodes. Furthermore, the menopause is characterized by numerous manifestations of abnormal vasomotor regulation, particularly of the extremities. Impairment of circulation to bone is thought to be a major factor in the production of osteo-arthritis. Regardless of the mechanism involved, the menopause is thought to be only a contributing factor and not a determinative one in the aetiology of Heberden's nodes.

### Radiological Appearance of Heberden's Nodes

A detailed study of the clinical and radiological appearance of Heberden's nodes indicate that marked changes in the fingers may be observed in radiographs taken in lateral views which are not suspected in conventional postero-anterior exposures (Stecher and Hauser, 1948). Lateral views reveal large exostoses arising from the proximal ends of the distal phalanges in the attachments of the extensor and flexor tendons. These may become quite large, almost enclosing the entire distal end of the middle phalanx. Such pronounced abnormalities are seen even in fingers which show only moderate changes in routine postero-anterior radiographs. It was also observed that marked enlargements of the fingers due to soft-tissue swelling occur before bony changes are revealed. Some attempt was made by means of serial photographs and radiographs to indicate the rate with which Heberden's nodes develop. Contrary to popular opinion, involvement of proximal interphalangeal joints with

osteo-arthritis was noted in 40 per cent. of the cases studied.

The features described are illustrated in the example shown. A photograph of the dorsum of the right hand (Fig. 2) shows a normal index finger and a nearly normal ring finger, a marked enlargement and flexion deformity without deviation of the middle finger, and a similar but less severe deformity of the little finger. Antero-posterior radiographs (Fig. 3) show normal index and ring fingers, and deformity of the middle finger which does not seem nearly as severe as the photographs would suggest. The little finger shows mushrooming of the ends of the bones with spurs. There is a knob-like enlargement of the distal end of the middle phalanx, with foam-like distortion of the trabeculae. The lateral radiographs (Fig. 4) show marked spur formation, not revealed in antero-posterior projection, arising from the attachments of the flexor and extensor tendons.

#### Neurotrophic Influences

Heberden's nodes rarely affect all fingers, and when they do so the fingers are likely to show appreciable variations in the degree of involvement. This characteristic is particularly noticeable during the early stages of the disease before the deformities are completely developed to their final and permanent shape. The local conditions which determine these differences in otherwise normal fingers are not recognizable. One influence which acts as a local determinant in allowing the development of Heberden's nodes has been identified. This is a normal and intact nerve supply. Defective nerve supply prevents the development of Heberden's nodes.

Numerous examples have been described of patients with Heberden's nodes on one hand but without nodes on the other hand, having several fingers the seat of trophic disturbances following a nerve injury. Such failure of development of Heberden's nodes was seen in denervation from severance of a peripheral nerve, due to atrophy of the hand following anterior poliomyelitis and to paralysis following apoplexy. One patient with well-developed Heberden's nodes bilaterally had a slight apparent decrease in their size on one hand 15 months after that hand was partly paralysed due to cerebral haemorrhage. This apparent decrease in size was the result of soft-tissue shrinkage because radiographs showed no change in the size of the finger bones. Nerve injuries or lesions of the central nervous system affect the vasomotor mechanisms in the paralysed areas, causing increased blood circulation to the bone and leading to osteoporosis. Heberden's nodes apparently do not develop in the presence of osteoporosis.

#### Other Clinical Features

Heberden's nodes exhibit considerable variation in their size, shape, and general appearances. In some instances "the little hard knobs" are apparent as the first manifestation of the disorder and remain as a characteristic feature of the deformity. In other instances there are no "little hard knobs" but a subcutaneous bar-shaped enlargement across the dorsum of the joint. In certain instances there is a general enlargement of the joint in all diameters. Flexion deformity may be slight or absent but is usually apparent, and it becomes marked if there is considerable enlargement. Deviation is the rule when enlargement is marked, but even then may be entirely absent.

Heberden's nodes may begin as a small, round, fluctuant, tender mass, a little to one side of the dorsum of the joint. This fluctuant mass may become as large or even slightly larger than any bony deformity of Heberden's nodes itself, but it usually decreases in size as the fluctuant nature of the enlargement changes to bony hardness. This explains how patients occasionally notice that their finger enlargements have become smaller. If these fluctuant masses are evacuated they yield a colourless, thick, jelly-like amorphous mass.

Fluctuant masses such as these have been described by Gross, who called them degenerative myxomatous cysts of the synovia (Gross, 1937). He stated that surgical removal was useless because the cysts recur repeatedly. He believed that x-ray radiation abolished them permanently. We have had no experience with x-ray radiation in this condition. We have seen three such cysts removed surgically. In each instance the patient subsequently developed Heberden's nodes at the site of the cyst. The largest nodes in each case were invariably on the finger which had been treated surgically.

Women of the working class invariably attribute their Heberden's nodes to the influence of hard manual labour or to the frequent exposure of their hands to water. That these opinions are not warranted is indicated by the fact that these deformities are equally common among women who have never done hard work or who have never had their hands in water except for personal bathing. The author knows of no evidence indicating that the production of idiopathic Heberden's nodes is influenced in the least by climate, occupation, diet, housing, environment, habits of living, the general state of nutrition, or conditions of general health.

#### Conclusions

Investigation of the natural history of Heberden's nodes reported here seems to justify certain con-

clusions. It is revealed that two conditions are necessary for the development of idiopathic Heberden's nodes. These include, first, the hereditary constitution or the genotype. This might be considered a theoretical supposition because the non-susceptible genotype is never recognizable; the susceptible genotype is recognizable only after the subject develops Heberden's nodes. The study in heredity indicates that about one-third of white women, 32.6 per cent.—29.9 per cent. as heterozygotes and 2.7 per cent. homozygotes—and 2.7 per cent. of white men as homozygotes are genotypically susceptible. The second condition necessary for the development of Heberden's nodes is an intact and normally functioning nerve supply to the hand and fingers.

Hereditary susceptibility and normal nerve supply may be considered as determinative factors.

Other factors which are not determinative but which seem to be secondary factors include race, age, and menopause. It is possible that each of these factors controls or modifies a separate condition which must be fulfilled to allow Heberden's nodes to develop. It is possible that each of these factors controls or modifies the same condition which must be fulfilled to allow Heberden's nodes to develop.

Although Heberden's nodes are a manifestation of osteo-arthritis they constitute a particular form of this disease with characteristics specific for this disease. Other forms of osteo-arthritis no doubt have particular characteristics specific for them. If they also were studied and the characteristics of different kinds of osteo-arthritis were compared, it seems that the fundamental nature of this general disease might be brought nearer to recognition.

Fig. 1 is reprinted with permission of the Editor of the *American Journal of Medical Sciences*. Figs. 2, 3, and 4 are reprinted with permission of the Editor of the *American Journal of Roentgenology and Radium Therapy*. Table 1 was constructed from material previously published (Stecher, 1940; Stecher and Hersh, 1944). Table 2 is taken from a previous study (Stecher, 1941).

#### REFERENCES

- Gross, R. E. (1937). *Surg. Gynec. Obstet.*, **65**, 289.  
 Heberden, W., Sen. (1772). *Med. Trans. College of Physicians*, **2**, 59.

- Heberden, W., Jun. (1803). "Commentaries on the History and Cure of Diseases." 2nd edit. T. Payne. London. p. 148.  
 Hogben, L. (1933). "Nature and Nurture." Norton and Co. New York.  
 "Report of the Sub-committee of the Council of Medical Women's Federation" (1933). *Lancet*, **1**, 106.  
 Stecher, R. M. (1940). *New Engl. J. Med.*, **222**, 300.  
 — (1941). *Amer. J. med. Sci.*, **201**, 801.  
 — (1946a). *J. Lab. clin. Med.*, **31**, 687.  
 — (1946b). *Arch. Phys. Med.*, **27**, 409.  
 — and Beard, E. E. (Unpublished.)  
 — and Häuser, H. (1948). *Amer. J. Roentgen.* (In press.)  
 — and Hersh, A. H. (1944). *J. clin. Invest.*, **23**, 699.  
 — and Karnosh, L. J. (1947). *Amer. J. med. Sci.*, **213**, 181.

#### Nodules d'Heberden

##### CONCLUSIONS

Les recherches ci-dessus sur la nature des nodules d'Heberden semblent justifier certaines conclusions. Elles ont révélé que deux conditions sont nécessaires au développement des nodules idiopathiques d'Heberden. La première est la constitution héréditaire ou le génotype. Cette hypothèse pourrait être considérée comme purement théorique car on ne peut jamais identifier le génotype des individus non sensibles, et le génotype sensible ne peut être affirmé qu'après l'apparition des nodules d'Heberden. L'étude génétique indique que, pour les femmes de race blanche, un tiers environ, 32.6 pour cent à 29.9 pour cent, comme hétérozygotes et 2.7 pour cent comme homozygotes, et 2.7 pour cent des hommes blancs comme homozygotes, sont génétiquement sensibles. La deuxième condition nécessaire au développement des nodules d'Heberden est l'innervation normale de la main et des doigts.

On peut considérer la sensibilité héréditaire et une innervation normale comme les facteurs déterminants.

D'autres facteurs moins importants sont la race et l'âge de l'individu et la ménopause. Il est possible que chacun de ces facteurs contrôle ou modifie un état déterminé qui doit exister pour permettre le développement des nodules d'Heberden. Il est également possible que chacun de ces facteurs détermine un même état qui permet le développement des nodules d'Heberden.

Bien que les nodules d'Heberden soient des manifestations d'ostéo-arthrite, ils constituent une forme particulière de cette maladie avec des caractéristiques spécifiques. Il est probable que d'autres formes d'ostéo-arthrites ont aussi des caractéristiques particulières qui leur sont propres. Il semble que si elles étaient étudiées également et que l'on compare les caractéristiques des différentes sortes d'ostéo-arthrite, on pourrait arriver à élucider la nature même de cette maladie générale.