the part that controversy has played in these developments escape notice. Controversy raged when blood transfusion was first introduced, and though to-day all but the eccentric or religiously biased would acclaim this great therapeutic advance debate will continue, profitably, on the details of its application. When 29 years ago Professor A. H. Burgess, professor of clinical surgery at Manchester University and honorary surgeon to the Manchester Royal Infirmary, gave his Presidential Address to the Association,[1] on "The Debt of Modern Surgery to the Ancillary Sciences," he also paid tribute to blood transfusion. In this context he mentioned "immuno-transfusion," in which patients with pyogenic infections were given blood from a donor who himself had first been actively immunized, and commented that this treatment was on trial and had met with some success. Though this controversial treatment did not survive in its crude form, we have to-day, descended from it, for example, the use of hyperimmune serum in generalized vaccinia or tetanus.

During the last thirty-five years there have been remarkable advances in curative medicine. This is undoubted, and well known to the public as well as to doctors. On television and radio, as Dr. Gerrard wryly remarked, curative medicine is "entertainment in quite a big way." We join with him in thinking, however, that a change of emphasis towards preventive medicine is now overdue. Pills and potions, those modern counterparts of the mediaeval talisman, are swallowed morning, noon, and night by the faithful. But how much healthier they would be if, instead, they took a little more exercise, ate sensibly, and smoked less! It is our duty as doctors—teachers—to say this, loudly and repeatedly. Dr. Gerrard is right when he reminds us of the importance of these things.

Asbestos and Malignancy

Since K. M. Lynch and W. A. Smith[1] described a case of lung cancer in association with asbestosis there has been increasing evidence connecting the two diseases.[2] More recently other malignant neoplasms have been associated not only with asbestosis but even with exposure to asbestos dust. S. R. Gloyne[2] found that 14% of a series of cases of asbestosis had carcinoma of the bronchus. He thought this all the more striking as 41% of the patients with cancer were women, while at that time primary carcinoma of the lung was distributed among males and females in the ratio of 4·4 to 1. R. Doll[3] calculated the average risk of lung cancer's developing in workers exposed to asbestos dust for 20 years or more to be ten times that in the general population. D. C. Braun and T. D. Truan,[4] in Canada, failed to show an association between lung cancer and asbestosis, but in Great Britain two annual reports of the Chief Inspector of Factories[5 6] have shown a high incidence of lung cancer in necropsies on patients with asbestosis.

Recently the story of asbestos and malignant disease has been taken a stage further. J. B. Enticknap and W. J. Smither[7] have described eleven cases of peritoneal tumours in asbestos workers, all of whom showed histological evidence of asbestosis. At least twenty years had elapsed between the first exposure to asbestos and the development of the tumour, and seven of the eleven patients had been exposed for more than ten years, though one worker had been exposed for only 10 months. Similar tumours associated with asbestosis have been described by others,[8-11] and at p. 214 and p. 211 in this week's *B.M.J.* Dr. Glyn Owen and Dr. P. B. S. Fowler and his colleagues describe more patients with diffuse mesothelioma of the pleura who had a history of exposure to asbestos but with no evidence of asbestosis. In a group of 632 insulation workers in the building trade followed for 20 years by I. J. Selikoff and his colleagues[12] cancer of the lung occurred seven times more frequently and cancer of the stomach, colon, and rectum three times more often than was expected. In addition, three mesotheliomas of the pleura and one of the peritoneum were found. While some of the workers in this survey may have worked in very dusty conditions others had been exposed only intermittently to materials containing asbestos. J. C. Wagner and his co-workers[13] described 47 patients with diffuse pleural mesotheliomas, all but one of whom had probably been exposed to crocidolite. Many of these patients were born on the South African asbestos fields, had gone to school near asbestos mines, or had played on asbestos dumps as children. Only eight of them had confirmed asbestosis. Since then more cases have been collected and 120 were reported by Wagner in 1963.[14]

Primary diffuse tumours of the pleura and of the peritoneum are rare, and their possible origin from mesothelial cells has been the subject of argument. Many diffuse pleural tumours have in the past been shown to be secondary to bronchial carcinoma, and this condition should be excluded[15] before a diagnosis of mesothelioma is made. Only four of 33 cases described as pleural mesothelioma by Wagner and his colleagues were confirmed at necropsy; in the rest the authors had to rely on clinical and radiological examination to exclude other primary sites of malignancy. Enticknap and Smither did not describe the peritoneal tumours which they studied as mesotheliomas, but instead preferred to use the term "peritoneal tumour of asbestosis." They described only peritoneal tumours, while Wagner and his colleagues described mainly pleural tumours and others have described predominantly bronchial carcinomata. The difficulty in identifying the diffuse tumours may be in part responsible for the differences in reported incidence, and the origin of this tumour may become clearer as more cases are described.

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[14] —— 11th International Congress on Occupational Health, 1963 [Manual].
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[16] Hutchinson, D. O'B., *Thorax*, 1961, 16, 258.
[17] Smither, W. J., Gilson, J. C., and Wagner, J. C., *Brit. med. J.*, 1962, 2, 1195.
[18] McCaughey, W. T. E., Wade, O. L., and [illegible], P. C., *ibid.*, 1962, 2, 1197.
[19] Harrington, J. S., *Nature (Lond.)*, 1962, 193, 53.
[20] Wagner, J. C., *ibid.*, 1962, 195, 180.

[1] *Brit. med. J.*, 1964, 2, 178.
[2] *Ibid.*, 1964, 2, 177.
[3] *Ibid.*, 1929, 2, 131.

D. O'B. Hourihane[16] has reviewed all the cases recorded as primary diffuse tumours of the pleura or peritoneum in the necropsy files of the London Hospital between 1917 and 1962 irrespective of exposure to asbestos. He accepted as mesotheliomata 17 out of 38 pleural tumours and 17 out of 55 peritoneal tumours with characteristics which clearly distinguished them from primary carcinomata of the lung or other viscera.

There appears to be no correlation between the degree of severity of asbestosis and the occurrence of pleural or peritoneal tumours, and in some cases the exposure to asbestos dust seems to have been slight. Information is being collected[17] to determine what proportion of these uncommon tumours occur in people who have been exposed at some time to asbestos dust. W. T. E. McCaughey and his colleagues,[18] reviewing 15 patients with mesothelioma of the pleura, found asbestos bodies in the lung in 12, most of whom were likely to have had some industrial exposure to asbestos. Asbestos bodies should certainly be looked for in the lungs of patients with mesotheliomata. However, it is difficult to assess the significance of this finding as long as the incidence of asbestos bodies in lungs without accompanying mesotheliomata is unknown. Hourihane found a significant incidence of asbestos bodies and fibres in the lung in his cases with mesotheliomata compared with consecutive necropsy cases of carcinoma of the lung and consecutive cases without a tumour in the chest.

On what does the probable carcinogenic action of asbestos depend? The members of the series of fibrous silicates to which the term asbestos is applied have different physical properties and chemical compositions. Chrysotile is a magnesium silicate with long, strong fibres suitable for spinning. Crocidolite and amosite are iron-containing silicates with shorter fibres. Many of the tumours reported so far have been associated with crocidolite, and some with chrysotile. If only certain varieties of asbestos are found to be associated with malignant disease a valuable clue might be provided. It has been suggested that because of its physical properties the asbestos fibre gives rise to chronic irritation and eventually to malignant change. J. S. Harington[19] extracted from crocidolite, and to a lesser extent from amosite, small amounts of fluorescent oils containing 3:4 benzpyrene and other polycyclic aromatic hydrocarbons which he thought had been produced by the primitive organisms present when the asbestos-containing rock system was deposited. The possible role of iron in the carcinogenic action of asbestos is also being investigated. Little experimental work on the carcinogenic effects of asbestos has been published. Wagner[20] obtained three mesotheliomata in 50 rats injected intrapleurally with asbestos, but he also obtained one similar tumour in a group of ten injected in the same way with silica.

There are many uses for the 2½ million tons of asbestos now being produced annually, and though the number of certified cases of asbestosis is decreasing more people may be inhaling a smaller concentration of the fibres, not only in industry but possibly also as a result of the contamination of the environment. If only certain varieties of asbestos are carcinogenic others could be substituted for them. Until we know the answers to some of the questions posed by the recent findings all exposure to asbestos dust should be considered as hazardous, and supervision should be extended to insulation workers in ships, factories, and domestic buildings who may be intermittently but nevertheless heavily exposed to [illegible]

Computers in Medicine

It is often said that medicine is applied biology. But [illegible] recently the idea that medicine might also become an important focusing point for mathematics and computer scie[nce] would have seemed strange to most people. A recent leadi[ng] article in these columns on automation in hospitals call[ed] attention to the fact that a time for revaluations is at han[d]. New methods are claiming a place in the traditional fram[e]work of medical research and practice.

Nothing could have given sharper emphasis to this th[an] the conference held in Oxford a fortnight ago on Mathemati[cs] and Computer Science in Biology and Medicine, organiz[ed] jointly by the Medical Research Council and the Minist[ry] of Health. The topics ranged from the latest metho[ds] developed in America for computer-aided processing [of] hospital records to the abstract logical and mathematic[al] problems underlying automatic classification, whether [of] diseases for diagnostic purposes, of organisms for taxonom[y] or of documents in systems of information retrieval. A seri[es] of distinguished speakers strove cheerfully, and on the whi[ole] successfully, to communicate at least in outline the mathe[-] matics involved in the analysis of electroencephalograms a[nd] electrocardiograms, in devising and testing models [of] epidemiological processes, and in interpreting changes [of] state in living tissues.

There are few in biology and medicine to-day who do [not] recognize that the new methods have come to stay and [that] the medical man must learn both to live with them and [to] exploit them for his own use. Yet most of us watch [the] advance of the computer with some apprehension. There [is] in addition a widespread belief that in order to use a comput[er] effectively one must, first, be very clever and, secondly, ha[ve] mathematics at one's finger-tips. Though perhaps valid [in] the early days of computers, these beliefs and apprehensio[ns] are now increasingly based on fallacy. In this context th[e] contributions to the Oxford conference may be picked o[ut] as opening doors to the use of computers as sophisticated research tools without the need for any special training [on] the part of the user beyond the capacity to think clearly.

R. S. Ledley, of the National Biomedical Researc[h] Foundation, Maryland, U.S.A., described to the Conferen[ce] a system for using the computer in the scanning and interpr[e]tation of photomicrographs of human chromosome prepar[a]tions. The system has several man-years of highly specialize[d] programming effort behind it. But now that the work ha[s] been done any cytologist may use the system or even mod[ify] and extend it by employing methods which can be learnt [in] an hour or so.

A further stage in the "spoon-feeding" of the user by [the] machine was illustrated in a dramatic demonstration by M. [V.] Wilkes, director of the Mathematical Laboratory, Cambridge University. From a lecture hall in Oxford he communicate[d] with an IBM 7094 computer in the Massachusetts Institute of Technology using G.P.O. Telex equipment. By typing an appropriate message into the teleprinter he activated a programme in the M.I.T. programme library which printed out its own operating instructions, interrogating and guiding the user at every step. A member of the audience was thus able to execute a complicated mathematical task without having to use anything beyond plain English. A further feature of the M.I.T. installation, remarkable by [any] standards, is that dozens of users can plug in to the [same]

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