of these disturbances due to two hypoxic factors: passive venous congestion secondary to right heart failure, and, predominantly, decrease of hepatic arterial blood flow due to shock. Follow-up studies showed that most liver function tests returned to the normal range. Other biochemical anomalies suggest the possibility of a specific etiological factor which might have acted via interference with pyruvate metabolism.

Résumé On a fait une compilation des principales analyses biochimiques effectuées par les divers laboratoires impliqués dans cette étude. L'observation la plus remarquable est l'augmentation des enzymes sériques. Leur origine hépatique est discutée. Des contrôles subséquents montrent que la plupart des épreuves de fonction hépatique redeviennent normales. Diverses autres observations suggèrent l'existence possible d'un facteur étiologique spécifique exerçant son action principalement sur le métabolisme de l'acide pyruvique.

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Quebec Beer-Drinkers' Cardiomyopathy: Electrocardiographic Study

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THE cardiac syndrome which struck Quebec beer drinkers several months ago revealed a number of interesting clinical and laboratory findings. To encounter such a large series, of almost epidemic proportions, in a relatively short time, is rather rare and indeed facilitated the precise description of this pathological entity which was hitherto unrecognized. It was thought that a special study of the electrocardiographic changes would be interesting because these were remarkably constant from one patient to another, varying only with the severity of the disease. By studying the electrocardiograms of 45 patients, we were able to observe major and rapidly evolving changes, which are reported here and compared with the observations made by different investigators on cardiomyopathy occurring in alcoholics.

The speed with which the pathology manifested itself in some of these patients is striking because the electrocardiograms substantiated the clinical and radiological findings in that they showed that the disease had begun only a few months before. In a few patients we had a chance to compare the electrocardiographic examinations made on admission with some recorded a few months previously when the patients had been investigated for other conditions. An example is shown in Fig. 1A and 1B, which demonstrate some rapid changes occurring in a 44-year-old patient.

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ADMISSION FINDINGS

The cardiac rate averaged 115 per minute, with a range of 90 to 160 per minute.

Arrhythmias were rare. There were isolated extrasystoles, i.e. one or two per tracing, in only two patients. The PR interval was found normal in all patients except in: (1) a case of atrial flutter in a patient who died 48 hours later, and (2) a case of nodal tachycardia in a patient who died the day of admission. One case of second-degree atrioventricular block occurred during treatment of a patient who survived; apparently due to digitalis, the block became first-degree two days after discontinuation of digitalis and eventually disappeared.

The P wave showed anomalies with significant frequency. Although the P axis in the limb leads remained within normal limits, varying between +30° and +90°, the axis in the precordial leads deviated towards the left and varied between 0° and −30° in 35 patients. The P waves generally had a peculiar pattern and were considered pathological in 28 cases. Five patients presented with a pattern characteristic of left atrial hyper-

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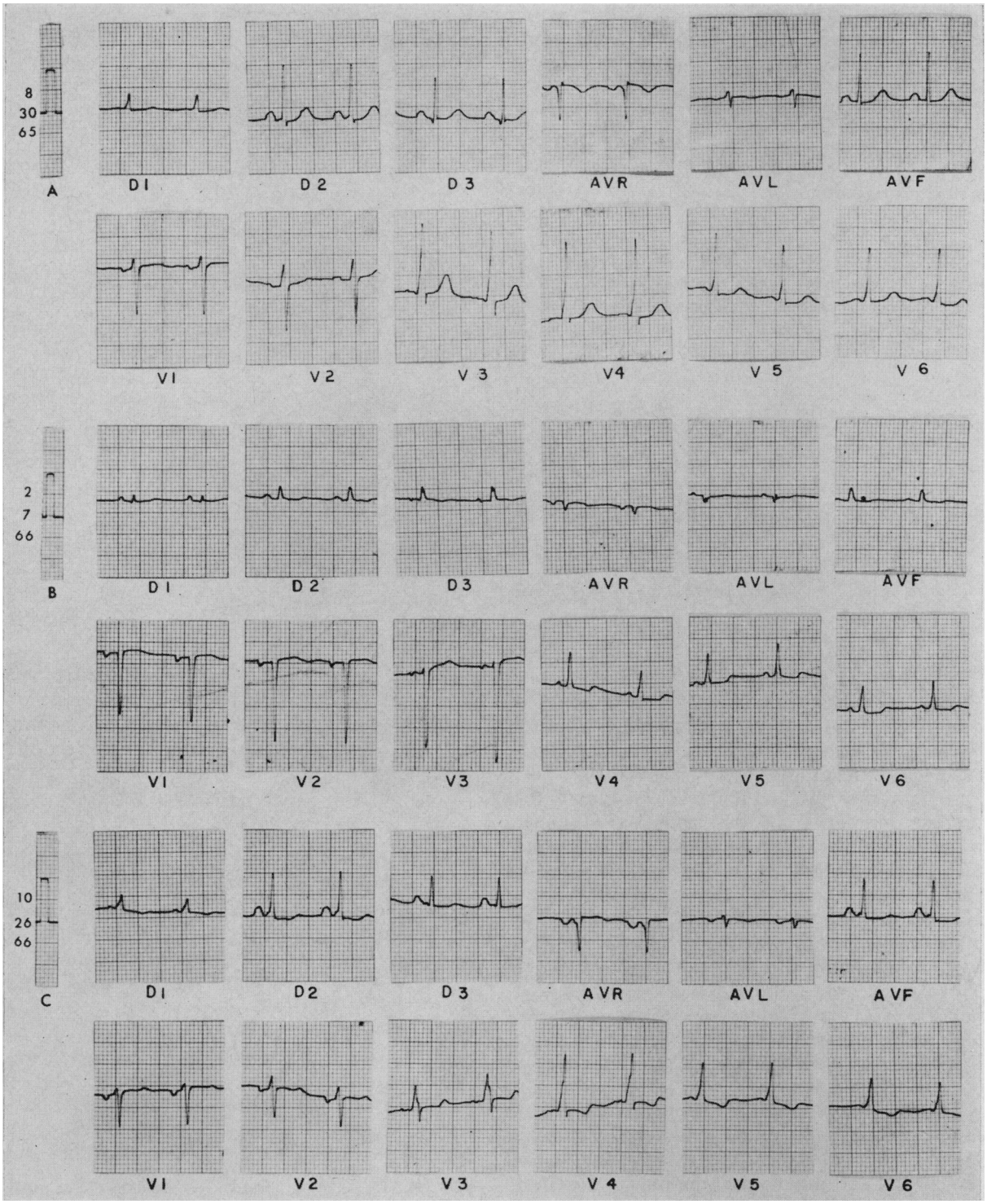

Fig. 1.—A 44-year-old man: (A) Electrocardiogram made in August 1965, which does not show any important anomaly. (B) Tracing recorded five months later, showing principally a very reduced voltage in the limb leads, slight elevation of the ST segment in the right precordial leads, a QS wave in V_1 and V_2, a minimal R wave in V_3, and anomalies of repolarization. (C) A follow-up made in October 1966 showing a clear improvement of the voltage and a normal progression of the R wave in the right precordial leads, but anomalies of repolarization persist.

trophy, and seven with that typical of right atrial hypertrophy. Sixteen others had non-specific anomalies, presenting at times a right atrial pattern, at times a normal pattern in the limb leads, but in the precordial leads the atrial electrical forces were deviated towards the left and poste-

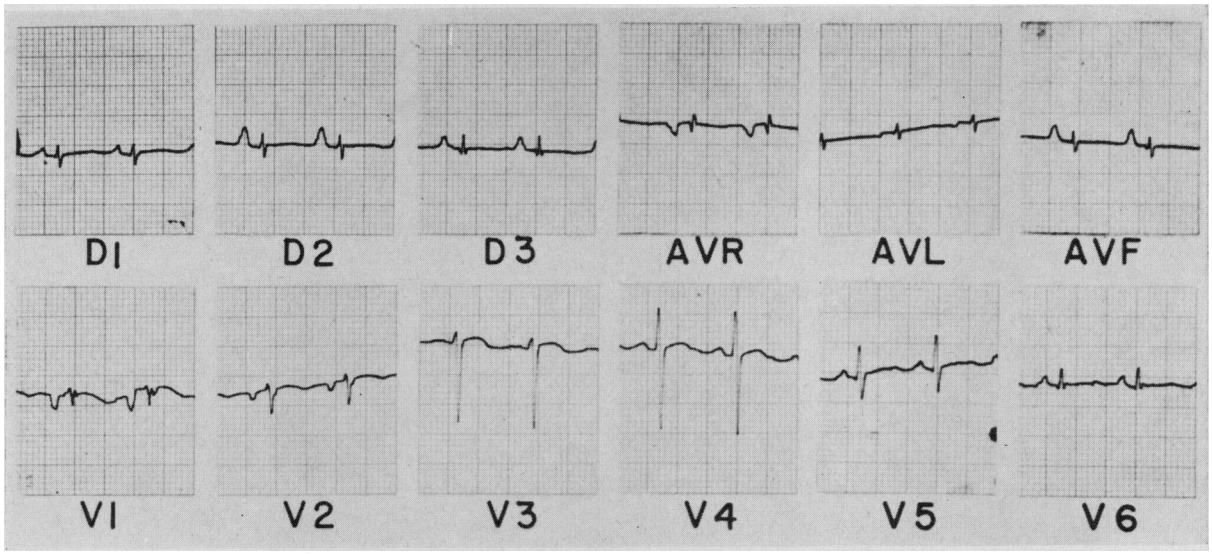

Fig. 2.—A 40-year-old man who died soon after. There is a tachycardia of 115 per minute, a marked microvoltage in the limb leads with a low voltage in the precordial leads, an abnormal P wave of right atrial enlargement pattern in the limb leads with deep negativity in V_1, an elevated and slightly convexed ST segment in V_2 and V_3, a transitional zone near V_5, a slow progression of R in V_2 and V_3, and finally flattened T waves throughout.

riorly, giving a deep negative P wave in V_1 and V_2 or a diphasic wave with a deep, slightly widened, predominantly negative component.

The duration of the QRS complex was found to be normal in every case. An intraventricular block was observed in one patient one hour preceding his death; it was not present beforehand.

The QRS axis in the limb leads fell between $-30°$ and $+90°$ in the majority of cases. A few tracings, however, had a right axis deviation; patients in two isolated cases had a left axis deviation, and in six patients the axis could not be determined.

One interesting and fairly constant observation found in nearly all patients was a marked reduction in voltage in the limb leads, i.e. the sum of the R waves in the three bipolar limb leads did not exceed 15 mm. in 41. In about 50% of these, there was also low voltage in the precordial leads.

The QT interval was normal in all tracings.

Other anomalies found with regularity among these patients included: (1) a slight elevation of the ST segment in the right precordial leads of 30 patients, amounting to several millimetres at times; (2) the transitional zone displaced to-

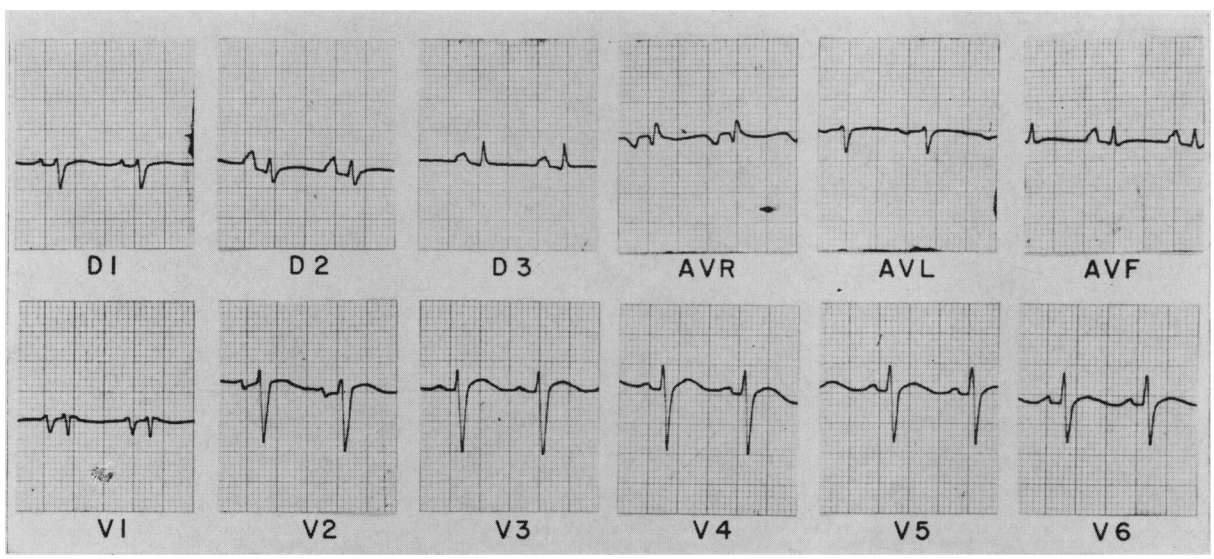

Fig. 3.—A 42-year-old man who died 36 hours after admission. There is a tachycardia of 110 per minute, a microvoltage, an abnormal P wave, an elevated ST segment in the precordial leads, a transitional zone overtaking V_6, an absence of septal activity wave in the left precordial leads, and non-specific anomalies of the repolarization.

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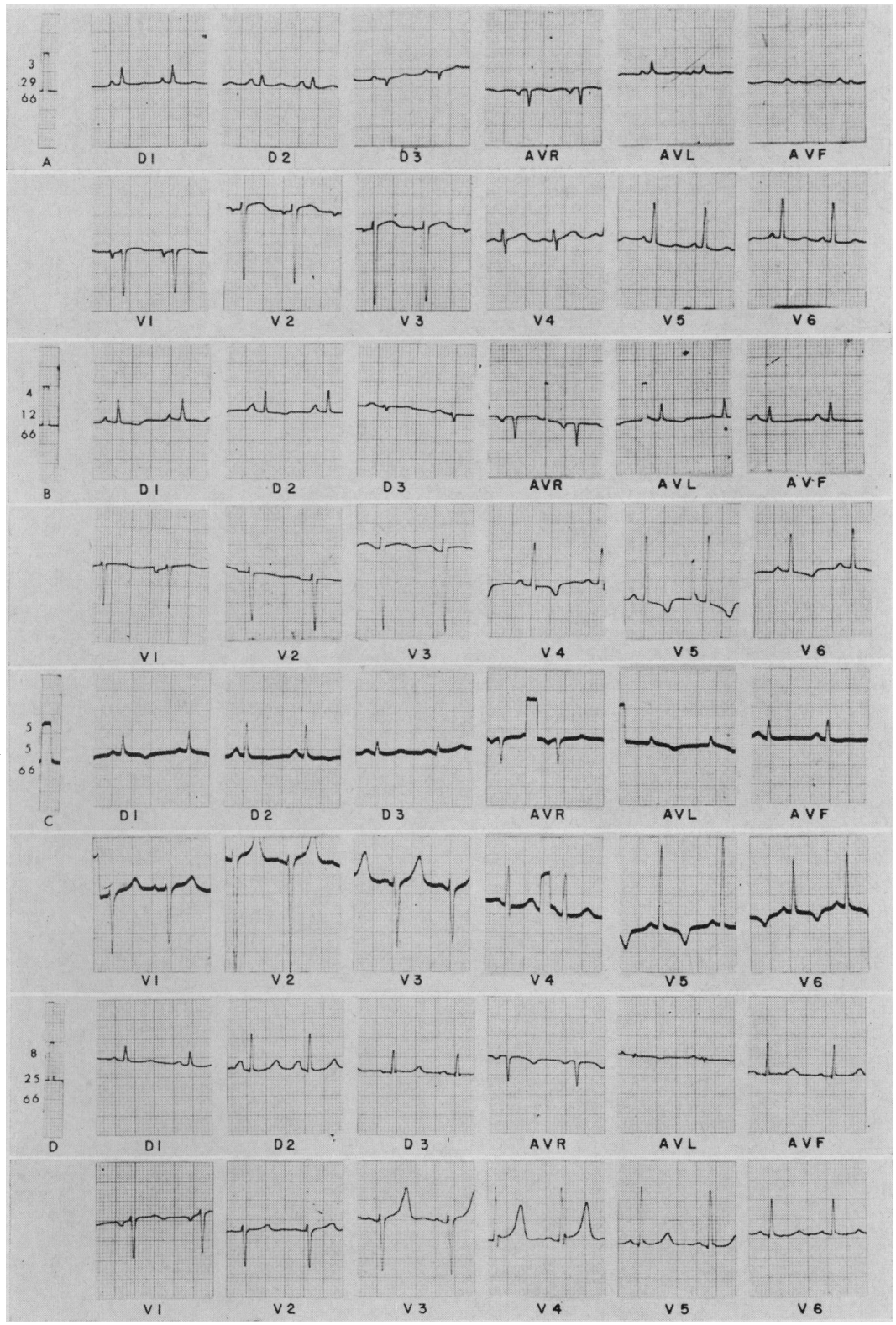

Fig. 4.—(A) ECG of a 34-year-old man taken on admission in March 1966. The rate is 115 per minute, the QRS is low in the limb leads, the P wave is abnormal in V_1, the ST segment is slightly elevated in the right precordial leads, the R wave progresses slowly in the right precordial leads and there is no wave showing septal activity in the left. The T wave is flattened throughout. (B) Tracing made 13 days later shows improvement of cardiac rate, voltage beginning to improve, and appearance of negative T waves. (C) Tracing recorded three weeks later: the voltage is of higher amplitude, the P wave in V_1 is normal and the T wave has acquired an ischemic pattern. (D) Nearly four months later, the tracing may be considered normal.

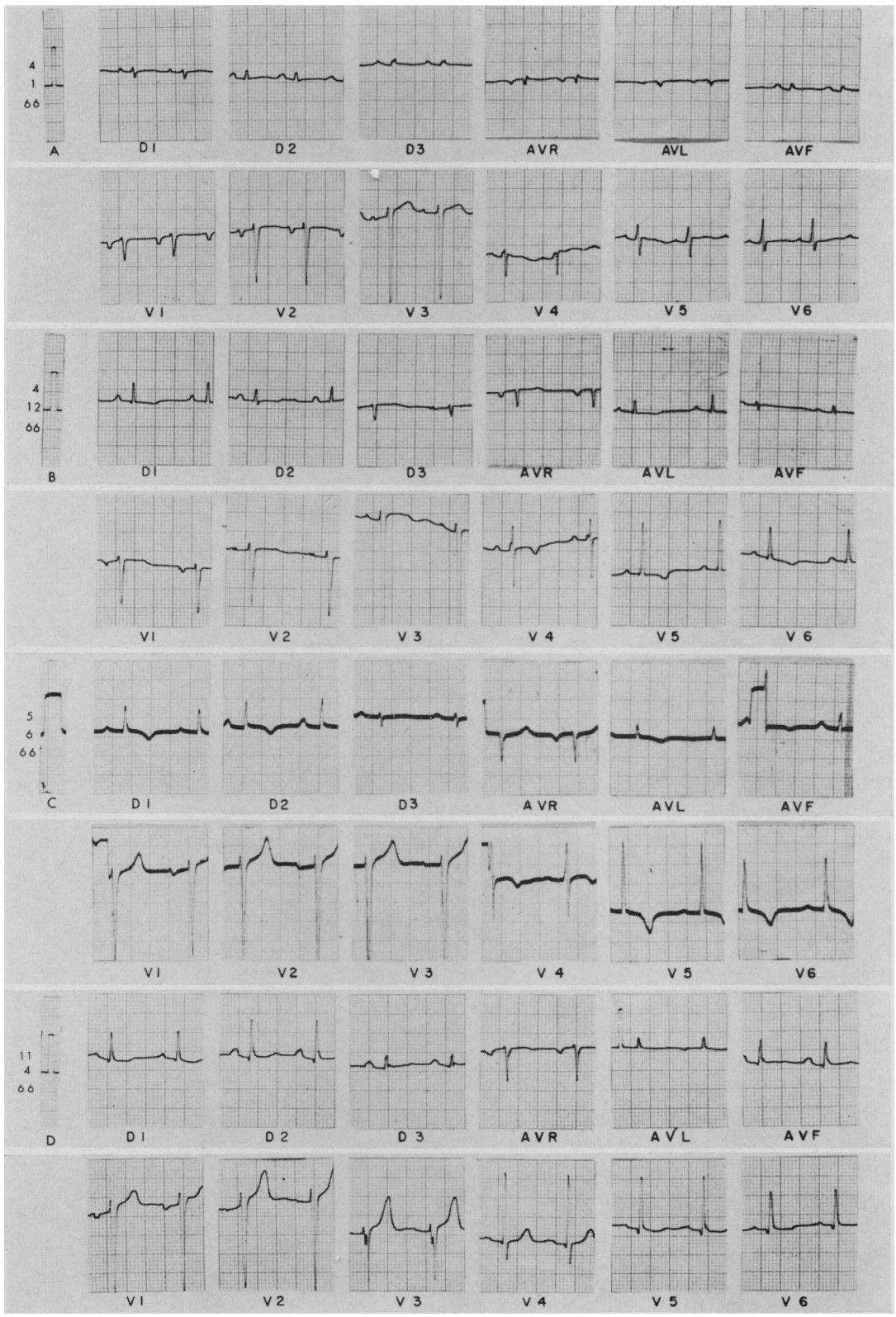

Fig. 5.—(A) ECG of a 34-year-old man at admission showing the same anomalies concerning rate, voltage, P wave, ST segment in right precordial leads, transitional zone towards the left, and non-specific T-wave anomalies. (B) After 12 days an amelioration of the rate noted, an improved voltage in the limb and precordial leads, an improved P wave in V_1 and V_2, a transitional zone displaced less towards the left, and the appearance of negative T waves. (C) Three weeks later, the ST segment in the right precordial leads no longer has the same form; the voltage is increased, and an ischemic T wave appears. (D) After six months, the tracing is almost normal, with minimal anomalies of repolarization.

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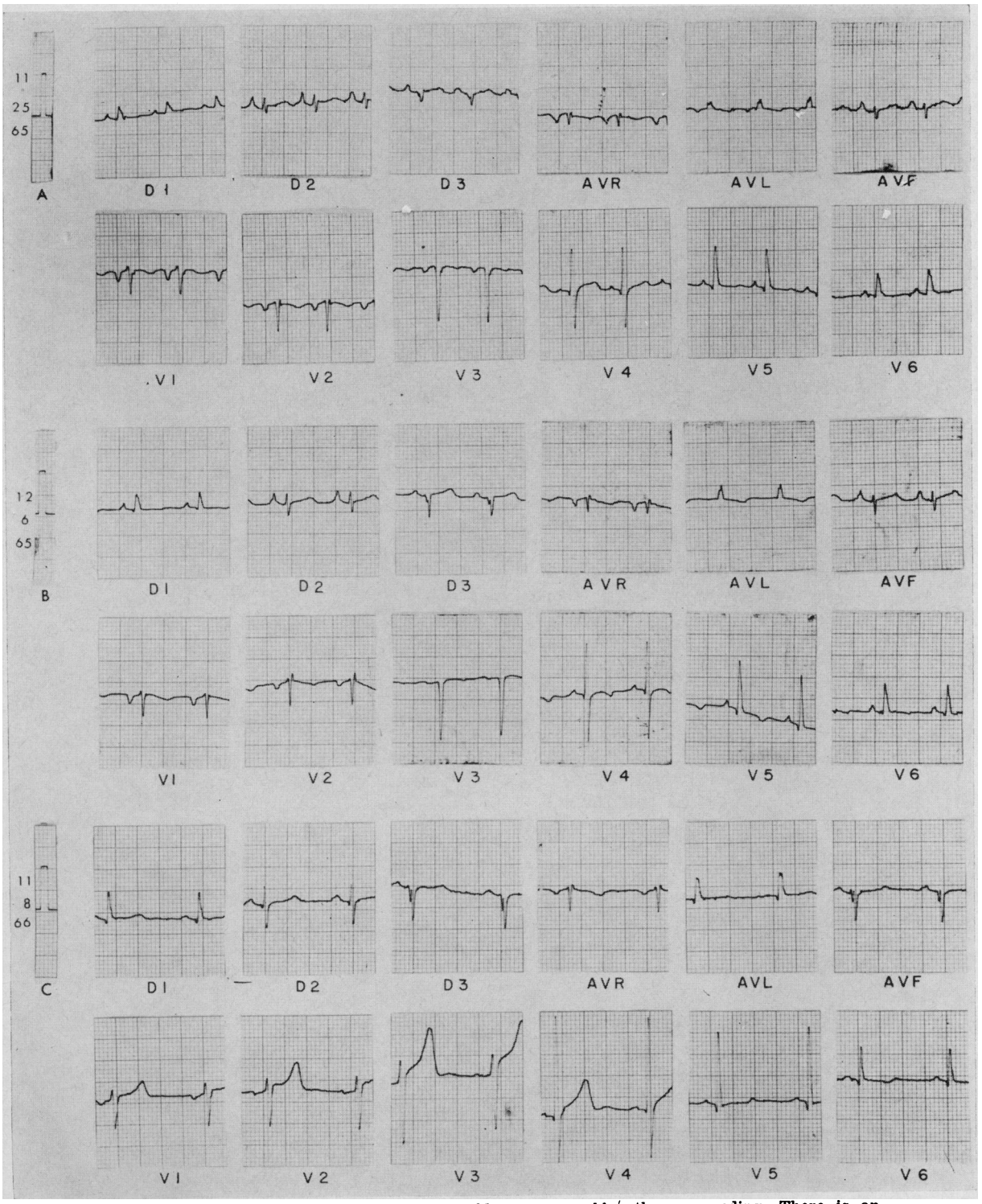

Fig. 6.—(A) This ECG of a 38-year-old man resembles those preceding. There is an absence of progression of R wave on the right, and a QS wave in V_3. However, a little wave of septal activity exists here in V_5 and V_6. (B) Evolution after 11 days. (C) A little more than 11 months later the tracing is almost normal, but minimal abnormalities of the T wave still exist in V_5 and V_6.

wards the left, beyond V_4 in 40 patients, of whom 23 went even beyond V_5 (this anomaly could possibly signify a right-sided dilatation); (3) a QS pattern in the right precordial leads in 14 and a slow progression of the R wave in the right precordial leads in another 20 patients; (4) in the majority of tracings (32 patients), an absence of Q waves, indicative of septal activity

in the left precordial leads; (5) some non-specific anomalies of the repolarization in 28 patients, but only two showed T waves typical of ischemia. These changes are illustrated in Figs. 1B, 2, 3, 4A, 5A and 6A.

RESULTS

Of the 45 patients whose electrocardiograms were studied, 18 died. Electrocardiograph tracings were repeated on 22 of the 27 survivors at 2 to 4 weeks and again at 4 to 8 months after discharge from hospital (Figs. 4B, 4C, 5B, 5C, 6B). A few patients were followed up by repeated tracings for about a year.

The cardiac rate improved in all patients, ranging between 75 and 100 per minute, and averaging 85 per minute.

After two to four weeks, of the patients in whom there were small QRS voltages in the limb leads and in the precordial leads, 18 of 22 showed marked improvement. In many the precordial voltage increased, being compatible with a left ventricular hypertrophy (Figs. 4C and 5C).

P wave abnormalities disappeared completely in nearly all cases. The amplitude diminished and in V_1 and V_2 the P wave became normal.

A regression of the elevation of the ST segment in the right precordial leads was observed in 11 of the 13 patients presenting this abnormality.

In 19 of 22 patients the transitional zone clearly moved toward the right.

The progression of the R wave in the right precordial leads improved in 12 of 18 cases.

However, the wave of septal activation in V_5 and V_6, reappeared in only 2 out of 14.

The repolarization was modified in 17 patients. Deep, symmetrical, negative T waves of the ischemic type appeared in the leads facing the left ventricle.

The course of the disease thus pointed to an attenuation of the different anomalies previously described with the development of distinctive T wave changes.

After four to eight months the improvement in the tracings were more evident (Figs. 1C, 4D and 5D). The anomalies which had persisted after the first month clearly regressed and, this time, the wave of septal activation in V_5 and V_6 reappeared in more than 50% of the tracings.

The ischemic T waves which appeared during the period of clinical improvement disappeared in nearly all cases. In 30% only slight anomalies of the repolarization persisted in the left precordial leads. In a few patients, however, the regression seemed slower; after initial improvement, minimal changes persisted in the recovery phase for nearly one year (Fig. 6c).

In summary, the numerous anomalies observed vanished as rapidly and as dramatically as they appeared, for the majority of electrocardiograms returned to patterns which could be considered within normal limits.

DISCUSSION

A review of many publications concerning the electrocardiographic anomalies encountered in alcoholics showed certain similarities in comparison with our series, without allowing us to draw any clear conclusions. The electrocardiograms of malnourished alcoholics with cardiac beriberi described by Benchimol and Schlesinger[1] and Blankenhorn *et al.*[2] showed the following similarities to those described here: (a) sinus tachycardia; (b) generally, the absence of arrhythmias; (c) frequently diminished voltage of the QRS and T waves, and (d) the occasional appearance of negative T waves accompanying clinical improvement; but they also differed from this series in that the patients with beriberi did not show septal activity anomalies or a change in the normal progression of the R wave in the right precordial leads. The electrocardiograms of the alcoholics described by Evans[3] differed from our series in that they showed frequency of arrhythmias and various T-wave anomalies such as "spinous" T waves, "dimple" T waves, "cloven" T waves and finally inverted T waves. The electrocardiogams of those large dilated hearts "in failure" due to myocardoses or to primary cardiomyopathy as described by Witham,[4] Dye *et al.*,[5] Massum *et al.*,[6] Sanders,[7] Sackner *et al.*,[8] and others, resemble ours in the following ways: (a) the presence of low voltage in the limb leads; (b) anomalies of the P waves; (c) left-sided septal activity abnormalities, and (d) the absence of progression of the R wave in the right precordial leads. However, unlike the changes reported by these authors, our series showed few signs of left ventricular hypertrophy, a scarcity of arrhythmias such as atrial fibrillation or extrasystoles, and finally an absence of conduction anomalies. The viral myocardites[9-11] are classically associated with arrhythmias, atrioventricular conduction abnormalities and intraventricular blocks.

In conclusion, the electrocardiographic studies of the Quebec patients revealed characteristic although not pathognomonic tracings, for these varied abnormalities were evidently non-specific. The extent of these changes as well as their multiplicity strongly suggests significant myocardial damage, while the rapid evolution of the ab-

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normalities is evidence of an acute or subacute reversible process. These distinctive electrocardiographic changes are compatible with a peculiar type of cardiomyopathy.

Summary The electrocardiograms of 45 patients, victims of the cardiomyopathy which recently struck Quebec beer drinkers, were studied. The most constant and important observations were: tachycardia; microvoltage of the QRS wave in the limb leads; P-wave anomalies; elevated ST segments in the right precordial leads; transitional zone displaced towards the left; abnormal septal depolarization; non-specific ST and T wave abnormalities; a paucity of arrhythmias.

After one or two months the various abnormalities regressed markedly, but modifications of repolarization appeared with deep, symmetrical, negative, ischemic T waves opposite the left ventricle. In nearly every case, within four to eight months, the negative T waves disappeared and the tracings reverted to normal. A comparative study with other series in the literature indicates a certain similarity but does not permit us to draw precise conclusions. The electrocardiographic picture suggests a cardiomyopathy of a new or at least unusual type.

Résumé Les tracés électrocardiographiques de 45 malades, victimes de la myocardiopathie qui a frappé récemment les buveurs de bière de Québec, ont été étudiés. Les observations les plus importantes par leur constance sont: une tachycardie; un QRS microvolté sur le plan frontal surtout; des anomalies de l'onde P; des segments ST surélevés en précordiales droites; une zone de transition qui se déplace vers la gauche; une dépolarisation septale anormale; des anomalies non spécifiques de ST-T; enfin, une rareté des troubles du rythme.

De façon assez impressionnante, après un à deux mois, les différentes anomalies régressent, mais apparaissent des modifications de la phase de repolarisation avec des ondes T négatives, profondes, symétriques, de type ischémique, en face du ventricule gauche. Après quatre à huit mois, ces ondes T disparaissent dans presque tous les cas, et chez la majorité des patients on note un retour du tracé vers la normale. L'étude comparative avec d'autres séries publiées par différents auteurs nous permet de faire certains rapprochements, mais ne nous permet pas de tirer de conclusion précise. L'image électrocardiographique nous suggère plutôt une myocardiopathie d'une forme nouvelle ou du moins, inhabituelle.

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